

THE

ELECTRICAL REVIEW

LONDON: PUBLISHING OFFICE, 22, PATERNOSTER ROW, E.C.

NEW YORK: D. VAN NOSTRAND, 23, Murray Street, and 27, Warren Street. Paris: Madame Veuve J. BOUTRY, Librairie
Etrangère, 22, Rue de la Banque. BERLIN: A. ASHER & Co., 5, Unter den Linden.

JOHNSON & PHILLIPS, TELEGRAPH ENGINEERS, ELECTRICIANS, AND CONTRACTORS.

OFFICES:—14, UNION COURT, OLD BROAD STREET, LONDON, E.C.

WORKS:—CHARLTON, KENT.

TELEGRAPHIC ADDRESS:—"JUNO" LONDON.

UNITED EXCHANGE TELEPHONE No. 1010.

PRIVATE WIRE, CITY OFFICES TO WORKS.

Manufacturers of all Telegraph Appliances, Materials, and Machinery for Making and Laying Submarine Cables, and Contractors for Underground and Aërial Telegraphs.

Iron and Steel Telegraph Buoys, Grapnels, both Patent and Ordinary; Centipedes, Creepers, Mushrooms, Sinkers, Cable Tanks, Picking-up and Paying-out Machinery, Dynamometers, Bow and Stern Gear, Steam and Hand Hauling Gears, Rope and Chain Fittings, Cable Drums, Splicing and Jointing Tools, &c., &c.

Machinery Designed and Constructed for the Complete Equipment of Telegraph Cable Factories and Vessels. Special Wire Sounding Machines for Shallow and Deep Water.

All Apparatus and Material used in the Construction, Maintenance, and Working of LAND LINES, viz.:—

POLES—Wrought Iron or Composite Poles of various kinds, for Telegraph, Telephone, and Electric Light purposes.

INSULATORS—*Johnson & Phillips' Patent Fluid Insulators*, and all kinds of the ordinary form, Shackles, Shackle Straps, &c.

WIRE—Iron and Steel Wire, Galvanised, Plain, or Stranded. Insulated Wires of all kinds.

BATTERIES—Sole Makers of *Higgins' Patent Bichromate Batteries*, and all the ordinary forms. Manufacturers of Zinc and Carbon Battery Plates of special quality.

INSTRUMENTS—Morse, Needle, Bells, Galvanometers, and other Testing Instruments.

MAKERS OF SPECIAL UNDERGROUND, AÉRIAL, TORPEDO, AND FIELD CABLES, WITH SINGLE OR MULTIPLE CORES.

Insulated Copper Wires, taped or braided, cotton or silk covered.

LIGHTNING CONDUCTORS OF THE MOST APPROVED TYPES.

ELECTRIC LIGHT—Makers of Electric Arc Lamps, Switches, Keys, &c.

SOLE MAKERS OF HIGGINS' CASCADE BATTERY.

EVERY DESCRIPTION OF LEADING WIRES AND CABLES. CARBON RODS AND PLATES.

ELECTRIC
LIGHT
LEADS,
of highest
Conductivity,
to any
Specification,
in
VULCANISED
RUBBER,
or the ordinary
insulations in
Stock.



CARBON RODS.
A supply always
on hand,
BLACK and
COPPERED,
in sizes varying
from 4 mm. to
20 mm.
diameter.
BATTERY
PLATES
in all sizes,
with or without
Terminals.

ESTIMATES GIVEN FOR COMPLETE SYSTEMS OF ELECTRIC LIGHTING.



Improved Portable Engine.

DAVEY, PAXMAN & CO.,
ENGINEERS, COLCHESTER, ENGLAND,
MAKERS OF ENGINES AND BOILERS SUITABLE FOR MILLS, FACTORIES,
ELECTRIC LIGHT INSTALLATIONS, &c., &c.

PORTABLE AND SEMI-PORTABLE ENGINES.
SEMI-FIXED ENGINES AND BOILERS.
HORIZONTAL ENGINES.
VERTICAL ENGINES AND BOILERS.
HORIZONTAL WINDING ENGINES.
VERTICAL HOISTING ENGINES AND BOILERS.

COMPOUND PORTABLE AND SEMI-PORTABLE ENGINES.
COMPOUND SEMI-FIXED ENGINES & BOILERS.
COMPOUND HORIZONTAL FIXED ENGINES.
CORNISH, LANDSHIRE & OTHER BOILERS.



Compound Fixed Engine.

Catalogues, Price Lists, Estimates, &c., sent free on application to

DAVEY, PAXMAN & Co., ENGINEERS, COLCHESTER, or to their
LONDON OFFICE: 139, QUEEN VICTORIA STREET, E.C.

SILVER MEDAL INTERNATIONAL ELECTRIC EXHIBITION, 1882.

ESTABLISHED 1868.

23 BOOTHS' MANCHESTER **WALTER T. GLOVER & CO.** WORKS SALFORD

LEADS & CABLES FOR

ELECTRIC LIGHTING

WIRE & CABLES FOR TELEPHONE, ELECTRICITY, &c.

ESTABLISHED 1868.

Contractors to H.M. Postmaster-General, the Indian Government, the principal Railway, Telephone, and Electric Light Companies.

MANUFACTURERS, BY PATENT PROCESSES, OF

GLOVER'S PATENT COVERED IRON WIRE FOR AERIAL LINES.

GLOVER'S PATENT COVERED GUTTA PERCHA WIRE FOR LEADING-IN, TUNNEL, AND UNDERGROUND WORK.

FANCY TELEPHONE WIRE AND TERMINAL CORDS.

SILK AND COTTON COVERED WIRE OF ALL CLASSES.

SPECIAL MAKES OF ELECTRIC LIGHT LEADS, CABLES AND MULTIPLE WIRE FOR THE VARIOUS SYSTEMS.

AERIAL AND UNDERGROUND CABLES, AND SPECIAL ANTI-INDUCTION CABLES FOR THE TELEPHONE.

WALTER T. GLOVER & Co.,

ELECTRICAL WIRE AND CABLE MAKERS.

25, BOOTH STREET, MANCHESTER.

WORKS:—Bridgewater Street, Broughton Road, Salford, and Salford Electric Wire Works, Salford.

N.B.—ALL COMMUNICATIONS TO BE ADDRESSED TO THE CHIEF OFFICE, 25, BOOTH ST., MANCHESTER.

LATIMER CLARK, MUIRHEAD & CO., LIMITED,

REGENCY STREET WESTMINSTER, S.W.,

AND AT

NORTHUMBERLAND WORKS, MILLWALL, E.,

ELECTRIC TELEGRAPH ENGINEERS & MANUFACTURERS

OR

MUIRHEAD'S PATENT COMPOUND TELEGRAPH POLES; GALVANISED IRON WIRE; INSULATORS; SPEAKING INSTRUMENTS;

APPARATUS FOR TRAIN SIGNALLING; BATTERIES; ELECTRIC AND PNEUMATIC BELLS; FIRE ALARMS; SUBMARINE CABLE INSTRUMENTS; PATENT DUPLEX AND QUADRUPLIX APPARATUS; CONDENSERS, &c.

ELECTRIC LIGHTING APPARATUS; DYNAMO MACHINES, LAMPS, CARBONS, LEADS, &c.

Electrical Standards and Testing Apparatus; Torpedo Cables and Exploders; Field Telegraphs.

FIELD'S PATENT NIGRITE CORE AND COVERED WIRES FOR CABLES, UNDERGROUND AND TELEPHONE LINES, TUNNELS, &c.

Copper Wires insulated with Gutta Percha, India Rubber, Silk, Cotton, Tape, &c.

BRAIDED WIRES.

Sole Manufacturers in the United Kingdom of Mance's Patent Testing Apparatus for Submarine Cable Work and the WERNER Arc Lamp.

Estimates given for the Construction and Maintenance of Telegraph Lines, and the Supply of Materials and Apparatus of every description.

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XV.—No. 363.

ELECTRIC LIGHTING FOR STEAM-SHIPS.

AMONGST those who have rendered good service in advancing the interests of the electric lighting industry by advocating its claims in an intelligent and practical manner, the name of Principal Jamieson should certainly be prominently mentioned for the efforts he has made to bring forward the question of ship-lighting. His latest contribution to the information we possess respecting the feasibility of applying electricity to the illumination of steamships, is in the form of a paper read before the Institution of Civil Engineers last Tuesday, in which he says that, although it is not more than three years since the first application of incandescent electric lighting to the general illumination of steamships, the advantages accruing from the light have been so fully recognised that already more than 150 ships have been fitted with it, and scarcely a man-of-war or first-class passenger steamer of importance now leaves the builder's hands without having it on board. In speaking of the best position for a dynamo on board ship, Mr. Jamieson says that where practicable the axes of dynamos with large, heavy armatures should be placed fore and aft, to obviate as much as possible the effects of gyrostatic action, since the angular velocity due to rolling is greatest athwartship. In dynamos where the weight of the armature, its velocity and radius of gyration, are small, gyrostatic effects will not produce any appreciable increase of pressure on the bearings, whatever the position of the dynamo. Further on in his paper, the lecturer discoursed of dynamos and how to select them, explaining the Siemens, Edison, Victoria, Ferranti and Pilsen-Schuckert machines as arranged for use on board ship.

As the success or failure of an installation depends very much upon the engine used as a prime mover, Mr. Jamieson devoted special attention to the consideration of this subject; and he claimed that one of the most important adjuncts to the engine is the governor, which should be sufficiently sensitive and reliable in action to keep the engine within 5 per cent. of its normal speed, with a load varying 90 per cent., and a boiler-pressure varying 10 lbs. per square inch. No mechanical governor will do this, and consequently great vigilance has to be exercised on the part of the attendant. Mr. Jamieson recently heard of a case in which 50 of the 200 Swan lamps on board a large passenger-steamer were suddenly broken through a failure of the governor. The lecturer stated that a good electrical governor, which shall automatically open and close the throttle-valve, in perfect synchronism with the load, or work to be done, and leave the valve in its last position until a change is made either in the load or in the steam-pressure, is greatly to be desired.

Having entered minutely into the various methods adopted for driving dynamos, such as with leather belts, cotton ropes, direct-driving engines, and the rolling contact or frictional driving gear of Messrs. Siemens Bros., Mr. Jamieson reached a very important point of his subject, viz., the system of leading wires and their sizes, insulation-resistance, &c. This is a subject which has been brought forward on many occasions in our columns, and it may not be amiss to quote a few of Mr. Jamieson's comments. After pointing out the advantages and disadvantages of the single and double wire systems, he says it is most important that the size of the conductor should be sufficient to carry the necessary current without causing more than 4 to 5 per cent. loss of electrical power developed in heating them, and that the insulation-resistance of the whole circuit when fitted, including all switches, &c., must not be less than 1,000 ohms per volt of electromotive force generated by the dynamo. Before fitting the wires, specimens of not less than 100 feet should be selected, immersed in sea water or brine-water for twenty-four hours, and then carefully tested for insulation-resistance, and not passed unless they give over 10 megohms. Specimen joints should be treated in the same way, and give at least 100 megohms each. It is seldom that on board ship more than 300 amperes are generated by any single dynamo; and as several main leads usually spring from the dynamo-room to various parts of the ship, the current in any one of them seldom exceeds 100 amperes, so the wires do not vary greatly in size, and generally four sizes will suffice for a ship.

We have over and over again enforced upon electric light engineers the necessity of paying the utmost attention to the matter of insulation resistance. Mr. Jamieson finds, as we have always suspected, that in the case of electric lighting those who are charged with the fitting up of an installation very seldom think of taking, or even know how to take, insulation tests, either of the dynamo or the leading wires. The professor himself has found great difficulty, in most installations with which he has been connected, to get the contractor to recognise the importance of this test; in fact, he has only met with one instance in which the contractor himself used testing apparatus which would detect a small flaw in the insulation of the wires after they had been fitted. To this general neglect of testing conductor-insulation and resistance may be attributed some of the failures that have occurred. As we have oftentimes stated, and as Mr. Jamieson himself expressly remarks, the insulation-resistance standard need not be nearly so high as in the case of submarine cables, but nevertheless it does require to be several hundred times more than the copper resistance, otherwise a fault will soon develop, the lead break down, and short-circuit under the combined influence of the currents and electromotive force used and damp or wet.

The excellent and highly practical paper concluded with some observations on switches, fusible junctions, lamp holders, lanterns, globes, &c., and a reference to arc lamps on board ship.

Mr. Jamieson's closing remarks, in which he quoted Mr. Preece, will form an appropriate termination to

our comments:—"It cannot be too strongly urged that specification without rigid inspection is valueless. . . . Many administrations object to the expense of thorough inspection, and the result is they are recipients of the rejected material of those who do rigidly inspect."

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—MONTREAL, 1884.

ON THE SEAT OF THE ELECTROMOTIVE FORCE IN THE VOLTAIC CELL.

By Prof. OLIVER J. LODGE.

(Specially reported for the "Electrical Review.")

(Continued from page 361.)

In volume 12 of Wiedemann's "Annalen," I find some interesting experiments by Schultzeberge on contact force between metals and gases. He uses a condenser in different gases, but the plates of his condenser are of the same metal. He coats one of the condensers with a film of gas, say, chlorine, or hydrogen, or ozone, and leaves the other covered with air. To measure the potential difference, he employed the compensation method of Pellat. His arrangement seems sensitive and satisfactory. Putting his plates under

be objected, as indeed it may with great truth be, that one man's life and capacity are not sufficient for this in the present state of knowledge, the objection constitutes a strong argument in favour of the proposition that the time has come for the organisation of science and a more definite division of labour.

To return however to the experiments of Herr Schultzeberge and to the result he obtained. His main experiment consisted in using a condenser with both plates of the same metal, but one contact with a film of gas, the other of air. Tried thus, ozone rendered air Au. Pt. and brass negative as against the corresponding air covered plate. Hydrogen rendered its platinum strongly positive, but its influence on gold was slight, and on brass uncertain. Chlorine and bromine made the platinum negative, and ammonia made brass positive. It was not easy to make quantitative experiments which agreed with each other, but he gives H. Pt. against air. Pt. about $\frac{1}{2}$ volt, and also gives other numbers. The only conclusion he draws from the experiment is the tolerably safe one, that the contact force between metal and gas is not necessarily the same as between metal and air. The extraordinary thing however is that some apparently equally good experiments previously made with the same method by Pellat had resulted in a conclusion that a condenser made of two different metals showed nearly the same volta effect whether the atmosphere surrounding the plates was air or hydrogen. I am unable to reconcile the discrepancy except by suggesting that perhaps Pellat did not take sufficient pains to remove the air originally in his bell jar and on both his plates.

Perhaps this is now the place to refer to the extraordinary and most erratic series of papers by Professor Franz Exner. He sets himself to dispose the existence of contact forces in the most straightforward and obvious manner and to establish the fact that there is no electrical evolution without definite and actual chemical action. To this end he announces the

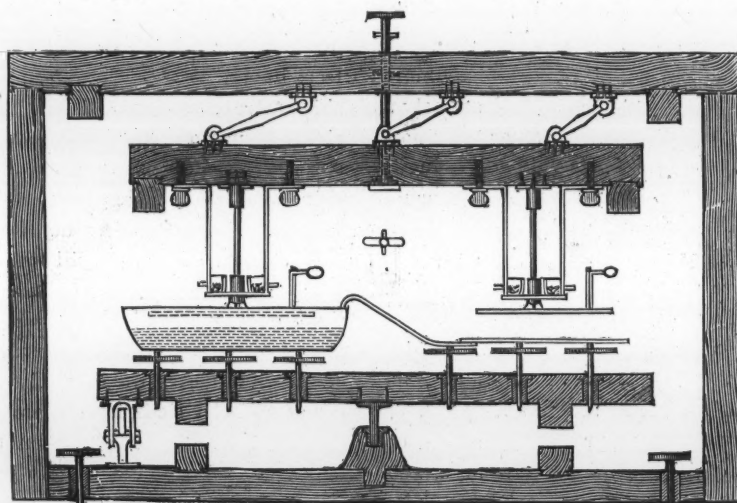


Fig. 7.

Ayrton and Perry's apparatus for observing and measuring the volta effect for all manner of substances, by a sort of Kohlrausch method; the plates being raised, rotated till reversed, then lowered again and put in connection with an electrometer.

an air pump he obtained an effect; but he was cautious enough to repeat the experiment by leaving the plates under the bell jar and not exhausting. He obtained the same effect, and attributes it to grease perhaps. This is the right sort of way to make experiments, and if everybody experimented with proper care there would be vastly fewer papers published in Germany, and science would progress, on the whole, faster. At present it seems to me overlaid with a mass of publications mostly, of necessity, by men of not absolutely the first order, much of it with no sort of clearness or insight, but rough, crude, and indigested. A man makes a number of experiments; he does not stop to critically examine and weigh them, and deduce from them their meaning, nor, indeed, does he even take the trouble to examine whether any definite meaning can in their then shape be drawn from them; but he rushes with them into print, producing a memoir of wearisome length and sometimes extreme illiterateness of style. Some one else, then, has the trouble of wading through the heap to see if any fragments of truth may perchance be embedded in it, and probably he is unable to come to any definite conclusion, because he cannot be in such a good condition for criticism as the original author was. He therefore writes a paper pointing out the defects and errors in the communication. Others take up the same line. The original man replies, and so there is a controversy and nothing is really settled at all. Finally, some one else independently goes over the whole ground from some distinct point of view, makes a few well-planned, clear and decisive experiments, describes them in a compact and readable form, and there results a definite gain to science. But how much better it would have been if this last paper had been the only one published. Unless a man is an experimental genius of the highest order, it is necessary for him to think for far more time than he experiments, if he wishes to advance, not to lumber his science. If it

following propositions: First, that two metals in a chemically indifferent medium show no electricity. Second, that the potential difference of two connected metals in air is exactly twice the difference of their heat combustion energy. Third, that two pieces of the same metal produce contact electricity so soon as they are put into chemically different atmospheres. The experiments by which he supports these assertions have been elaborately and severely criticised by Beetz, Hoorweg, Schultzeberge, von Zahn, Ayrton and Perry and Wiedemann and his numerical determinations of contact force appear to be unique. It is not necessary for me to enter into a discussion on the merits of his experiments inasmuch as the mere fact of so great a body of hostile opinion is sufficient to show that they were not of a kind best qualified to produce conviction. The theoretical views which led Prof. Exner to formulate his second statement above that the potential difference of two connected metals is equal to twice their heat combustion per equivalent, is I am sorry to say quite unintelligible to me. They depend on the hypothetically necessary existence of films of oxide, between which and the metal there is supposed to be a considerable difference of potential. He has got hold of the notion that the heat of combustion has some sort of relation to the volta effect, and there I am heterodox enough to agree with him, but what the relation is and how it acts and what sort of potential difference you ought to expect in accordance with theory, concerning all these things I am utterly at variance with him, and I deem it prudent not to attempt to represent views which I am unable to understand because it is not likely that I should do them justice. Prof. Exner to strengthen his position adduces a large number of very simple experiments (such as connecting first one Daniell and then two Daniells to an electrometer and observing that in the second case the deflection is double the first): and from these he obtains equations algebraically representing that $Zn/Cu = 0$. Considered as conundrums

these equations are ingenious, but it is a waste of time seriously to discuss them, as Herr Julius has done in an elaborate manner. To suppose that such every day experiments as these are in direct contradiction to the contact theory, is scarcely complimentary to the great men who have held, and who still hold that view. There are one or two minor papers to which I may refer before closing this historical sketch of what has been done in the subject of the volta effect, for instance that by Dr. G. C. Knott and by Mr. Lavington Hart, but there is hardly time.

The result of this survey in regard to our special subject of discussion may now be summed up. 1st. There is certainly an E.M.F. at the junction of two different substances or even of the same substances in two different states; and secondly, the total E.M.F. of a circuit is the algebraic sum of all such contact forces at every junction in the circuit. I do not know that these two propositions could be passed *nem. con.*, but I believe that, provided they are properly understood, the dissenting minority would be a very small one. It is probable that Prof. Exner would be in the minority, but I am unable to be sure of anyone else. We can also make a negative proposition which will command almost universal assent, namely, that if in the above second proposition, instead of the sum of the contact forces at every junction, we attend only to the contact forces at the metallic junctions, the proposition will no longer be true. This fact, that the metallic junctions are insufficient to account for all the E.M.F., was established completely by Becquerel and De la Rive, and then, and still more completely and exhaustively, by Faraday. It is the easiest possible thing to make any number of batteries which shall give a current without any metallic junction whatever. So much being agreed to, what remains as subject matter for controversy? This: a voltaic current contains at least three junctions. What is the value of

The experimenter assumes that M/M' is what he is measuring; but there is no proof to be given in support of the assumption, except that if you substitute water for air the effect remains almost unaltered; but then water contains oxygen as an active element, the same as air does. Well, then, the effect is the same in *vacuo*, and in hydrogen, to which I answer: "Not proven."

Can any further assertion be made with reference to electroscopic experiments as supporting a Voltaic theory? Yes; it can be asserted that by adding up the Volta effects, obtained by experiment, upon open circuits, you get the total E.M.F. for a closed circuit. But what then? What you call A/B is really

$$\text{air}/A + A/B + B/\text{air}$$

what you call B/C is

$$\text{air}/B + B/C + C/\text{air}$$

and what you call Z/A is

$$\text{air}/Z + Z/A + A/\text{air}$$

Add them up, and you get $A/B + B/C + \dots + Z/A$,

which must be the E.M.F. of a circuit by common sense, that is without violent experimental disproof, which no one has ever attempted to give. This fact that the sum of the Volta effects equals the sum of the true forces in a closed circuit of any materials has, nevertheless, caused persons to suppose that the air-metal force was negligibly small. They may have any value they like without affecting the truth of the case. The only way they could affect it is for air/M not to be equal to $-M/\text{air}$.

Leaving electrostatic determinations as without bearing on the point at issue, let us ask, is there no direct and straightforward

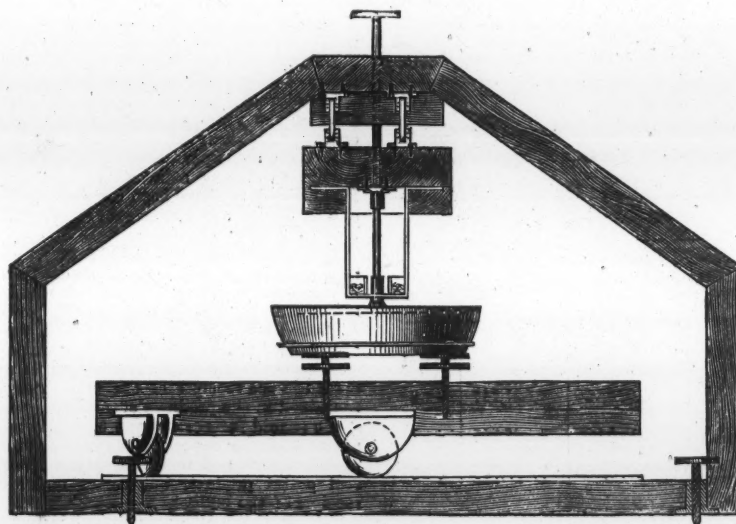


Fig. 8.

Ayrton and Perry's apparatus: end view.

the contact force at each of these, and especially, to which junction is the major part of the observed E.M.F. due? Is it the zinc acid, or is it the copper acid, or is it the zinc-copper? There is no other question. The old chemical and contact controversies have died out; but another controversy remains. Most persons would say to-day, that the major part of the E.M.F. of the cell resides at the zinc-copper junction. This was Volta's view; and this is the view taken by the text book writers taught

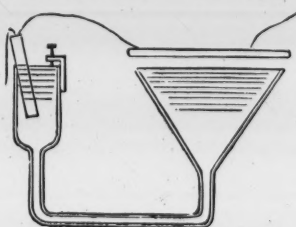


Fig. 9.

Hanke's modification of Kohlrausch's method for measuring the volta force between metals and liquids.

by Sir Wm. Thomson. A few persons would say, "At the zinc acid junction," and amongst them I must confess myself. It is no question between contact and something else; it is a question between a feeble energy-less metal-metal contact, and an active energetic metal-fluid contact, with potentialities of chemical action straining across the junction.

What is there to distinguish between the two? Electrostatic experiments with air condensers prove nothing. They add up three E.M.F.s: $\text{air}/M + M/M' + M'/\text{air}$, and give you the sum.

way of measuring the actual E.M.F. at a particular junction without disturbance from other junctions? The answer is most clearly given by Maxwell thus: "Sir Wm. Thomson has shown that if π is the coefficient of the Peltier effect, or the heat absorbed at its junction by unit current in unit time, then π is the E.M.F. at that junction acting with the current. This is of great importance, because it is the only method of measuring a local E.M.F., the ordinary method of joining up by wires to an electrometer being useless. This Peltier measurement is quite independent of the effect of contact forces in other parts of the circuit; but this E.M.F. does not account for Volta's force, which is far greater and often opposite. Hence the assumption that the potential of a metal must be measured by that of the air in contact with it must be erroneous, and the greater part of Volta's E.M.F. must be sought, not at the junction of two metals but at one or both of the surfaces which separate the metals from the air, or other medium, which forms the third element in the circuit."

And in another place he says: "In a voltaic circuit, the sum of the electromotive forces from zinc to the electrolyte, from the electrolyte to copper, and from copper to zinc, is not zero, but is what is called the electromotive force of the circuit—a measureable quantity. Of these three electromotive forces, only one can be separately measured by a legitimate process, that, namely, from copper to zinc. If we cause an electric current to pass from copper to zinc, the heat generated in the conductor per unit of electricity is a measure of the work done by the current per unit of electricity, for no chemical or other change is effected. Part of this heat arises from the work done in overcoming ordinary resistance within the copper and the zinc. This part may be diminished indefinitely by letting the electricity pass very slowly. The remainder of the heat arises from the work done in overcoming the electromotive force from the zinc to the copper, and the amount of this heat per unit of electricity is a measure

of this electromotive force. Now, it is found by thermo-electric experiments that this electromotive force is exceedingly small at ordinary temperatures, being less than a microvolt, and that it is from zinc to copper. Hence the statement deduced from experiments in which air is the third medium, that the electromotive force from copper to zinc is 0.75 volts, cannot be correct. In fact, what is really measured is the difference between the potential in air near the surface of copper, and the potential in air near the surface of zinc, the zinc and copper being in contact. The number 0.75 is therefore the electromotive force, in volts, of the circuit copper, zinc, air, copper, and is the sum of three electromotive forces, one only of which has as yet been measured."

With every word of Maxwell I cordially agree, and I shall not inflict upon the meeting any more of my own ideas at present.

(To be continued.)

THE ORGANISATION OF THE POST AND TELEGRAPH SERVICE IN FRANCE.

(Continued from page 290.)

THE lowering of the rates, of course, caused a falling off in the receipts. The committee of supply estimated that the losses on the estimated products of the postal service for 1878 would amount:—

For the first year to ...	18,000,000 francs
" second year to ...	12,000,000 "
" third year to ...	4,800,000 "

This estimate was even considerably lower than the estimates and calculations of special officials.

The committee thought that it would not be until in the fourth year from the date of the reforms that we would obtain receipts equal to the original estimates of receipts for 1878, made out according to the old tariffs.

As regards the telegraph receipts, the committee of supply expected a loss of not more than 1,200,000 francs, applicable only to the first year of the reform.

The following table shows the results of the postal and telegraph reform per year, starting from the 1st of May, 1878:—

Year of Reform.	Products.	Corrected estimates of the Committee of Supply.	Excess of the products over the estimates.
POSTS.			
1st May, 1878, till 30th April, 1879 -	100,497,717	95,876,000	4,621,717
1st May, 1879, till 30th April, 1880 -	106,538,855	101,876,000	4,622,855
1st May, 1880, till 30th April, 1881 -	116,533,709	109,076,000	7,457,709
TELEGRAPHS.			
1st May, 1878, till 30th April, 1879 -	21,473,507	16,217,000	5,256,507
1st May, 1879, till 30th April, 1880 -	24,199,997	17,417,000	6,782,977
1st May, 1880, till 30th April, 1881 -	26,592,201	17,417,000	9,175,201
POSTS AND TELEGRAPHS.			
1st May, 1878, till 30th April, 1879 -	121,971,224	112,093,000	9,878,224
1st May, 1879, till 30th April, 1880 -	130,738,832	119,293,000	11,445,832
1st May, 1880, till 30th April, 1881 -	143,125,910	126,493,000	16,632,910

If, instead of examining the results obtained each year of reform, we were to seek what were the consequences of this lowering of rates on the annual budgets, we should have to add to the expenditure during the financial years the losses foreseen by the committee of supply for the first three years of the reform.

This would give us the following distribution:—

	Post. Francs.	Telegraphs. Francs.
Estimate, 1878 (eight months of the first year of reform), loss ...	12,000,000	800,000
Estimate, 1879 (four months of the first and eight months of the 2nd year of reform), loss ...	14,000,000	400,000
Estimate, 1880 (four months of the second and eight months of the third year of reform), loss ...	7,200,000	...
Estimate, 1881 (four months of the third year of reform), loss ...	1,600,000	...
Totals ...	34,800,000	1,200,000

The following table shows, per financial year, the surplus of the receipts over the estimates:—

Years.	Posts.	Telegraphs.	Grand total of the products.	Estimates.	Excess of the products over the estimates.
Original estimates of Products of 1878	113,876,000	18,882,000	132,758,000	...	pr. cent
" " 1877	119,521,077	19,678,438	139,199,515	...	...
" " 1879	102,335,630	21,204,627	123,540,257	119,938,000	3,602,257
" " 1880	104,715,888	22,915,839	127,631,727	118,338,000	9,293,727
" " 1881	112,687,493	25,612,426	138,299,919	126,638,000	11,641,919
" " 1882	123,638,575	29,193,916	152,832,491	131,168,000	21,674,491
" " 1883	126,333,610	28,219,630	154,553,240	132,738,000	21,794,640
" " 1884	132,138,000	28,036,000	160,174,000	132,738,000	27,436,000

If we compare the products of each of the years 1878 to 1883 with those of the preceding year, we obtain the following results:—Products of 1878—123,560,277 francs; products of 1879—127,627,527 francs, or an increase of 4,067,250 francs over the year 1878; products of 1880—138,299,919 francs, or an increase of 10,672,392 francs over the year 1879; products of 1881—152,832,491 francs, or an increase of 14,532,572 francs over the year 1880; products of 1882—154,552,640 francs, or an increase of 1,720,149 francs over the year 1881; products of 1883—161,094,000 francs, or an increase of 6,541,360 francs over the year 1882. These facts have thus given figures, which are considerably higher than the estimates.

Since 1880 we have reached the level of the receipts of 1877; in 1883 we have exceeded it by twenty-two millions. Up till 1870 the net product of the posts and telegraphs together has fluctuated at about twenty millions. It amounted to 20,438,601 francs in 1860. During the following years it became nineteen millions and eighteen millions, then decreased to sixteen millions in 1864, and not till 1867 did it amount to 21,996,768 francs, whilst in 1869 it was as high as 27,529,754 francs.

When, after the events of 1871, the rates were increased, the net product immediately ran up to thirty-six millions.

During the two or three last years previous to the reform, the figure of the net products amounted even to over forty millions.

In order to be able to compare the present net product with that of the years previous to 1879, the figures referring to the operations of those latter years should be increased:

1. With an expenditure of 45,000 francs, the amount of the credits previously attached to the Central Administration of Finances, which have been carried over to the budget of the posts and telegraphs, at the time of the creation of the Ministry, as belonging to the latter.

2. With a receipt of 571,149 francs, representing the reimbursements paid by the railway companies for the costs of superintending their telegraph service, and which, only since 1878, are included in the postal and telegraph products.

There should further be subtracted from these figures the sum of 279,077 francs, the amount of the rates referring to telegrams of Algerian origin, which, before Algeria was connected, was included in the receipts of the metropolis, and which at present is contained in the products of Algeria.

We should further observe that the receipts do not include the amount of the deposited money articles not claimed from the postal officials and forfeited to the Treasury, and which forms a real postal product, but comes under the heading of sundry receipts of the budget.

Taking these elements into account, we find that the net product of 1876 was 43,412,785 francs; that of 1877 amounted to 46,275,976 francs (not including an exceptional receipt of 1,200,000 francs proceeding from the carriage of newspapers and circulars during the time of the elections).

It was precisely because of this increase of the products that we thought it possible to reduce the tariffs. Moreover they are exceptional net products which had not served as basis for the making out of budgets. Indeed the projected budget of 1878, prepared before the reform, without any consideration of reducing the tariff, gave the receipts as equal to 132,187,260 francs, and the expenditure as equal to 91,941,632 francs. The net product, calculated on the same conditions as those of 1876 and 1877, amounts to 40,537,700 francs.

The simultaneous reduction of the telegraph rates which took place on the 1st May, 1878, of course, would involve a considerable falling off in the net product. This decrease could not be attenuated but by an increase of the traffic. This is what the Chambers had foreseen when they voted the reduction, and what the results have justified; this is indisputably proved by the figures we will give: a previous observation, however, is required. In order to make an exact estimate, the fact should be taken in account, that the budgets of 1881, 1882, 1883 and 1884 included new expenditures of an exceptional character, and which had not occurred in the previous years; therefore, in order to establish a just comparison, these expenditures should be deducted when making out the net product.

Thus the budget of 1881 was burdened with a sum of 429,042 francs, as part of the costs of establishing a new cable from Marseilles to Algiers, with 217,920 francs as part of the installation of the Works at Toulon, with 114,700 francs for the Exhibition of Electricity and the Congress of Electricians, with 425,840 francs for the settlement of treasury advances applicable to previous budgets; or a total of 1,187,562 francs.

In 1882 a new maritime service, voted by the Chambers for Australia and New Caledonia, involved a subvention of 461,922 francs (for the months of November and December); the expenditure for the Congress of Electricians amounted to

48,766 francs; the Works at Toulon to 79,706 francs; or a total of 600,394 francs.

In 1883 the expenditure to be deducted to compare the net product with that of the previous years included 2,460,730 francs for the subvention of the service with Australia (a whole year); 1,700,000 francs for the cable to Senegal, voted at the request of the Ministry of Marine; 151,141 francs for the Conference of Electricians and the Exhibition in Vienna; or a total of 4,311,877 francs. By not taking in account these exceptional expenditures, as well as the receipts and expenditures of Algeria, which, only since 1881, are included in the budget of the posts and telegraphs, we obtain for the net products, compared with those of previous years, the following results.

Budget.	Receipts.	Expenditure.	Net Product.	Total Net Product.
1878...	123,281,200	97,646,730	25,634,470	25,634,470
1879...	127,334,102	105,303,604	22,030,498	22,030,498
1880...	138,055,323	106,925,867	31,129,456 + 302,500*	31,431,956
1881...	152,832,491	116,638,734	36,193,757 + 632,575*	36,826,328
1882...	154,552,640	123,431,597	31,121,043 + 880,000*	32,001,043
1883...	161,094,000	129,830,140	31,263,860 + 880,000*	32,143,860
1884...	166,408,000	132,515,815	33,892,185 + 880,000*	34,772,185

Thus the year 1878, from the first of May of which year new rates were applied, only gave a net product of 25,600,000 francs. For the year 1879, the whole of which was submitted to the regimen of the reduced rates, the net product dropped to 22,030,498 francs; the lowest figure since the reform. Since 1880, owing to the development of the traffic, it rose to 31,120,456 francs and in 1881 amounted to 36,826,338 francs, notwithstanding the improvements of all kinds introduced in the service, and the increase of the expenditure caused thereby.

The progression was affected by the crisis of 1882; but, as shown in the table, the increase of receipts over the preceding years went on. 1882 gives a slight augmentation over 1881, but the products of 1883 exceed by more than six millions those of 1882, and we are getting on to obtain a net product of 40 millions. When we have obtained that, the success of the reducing of the rates will be complete.

We shall have given to commercial transactions the advantage of reduced rates, on the whole by nearly one half, and, owing to this fertile reform, we shall have obtained such an increase of traffic that we approach the largest previous net products.

At the same time we have been able to introduce great improvements in the postal and telegraph service, especially in the interest of the staff; these improvements involved heavy expenses, which have also been compensated for by the increase of the receipts.

To appreciate, moreover, the share contributed by the posts and telegraphs to the general resources of the State, we should not forget that the subventions to the maritime services, which are of great national interest, but which cannot be called real postal expenses, are included to a considerable amount in the budget of the posts and telegraphs.

On the other hand, the service of posts and telegraphs carries free a large number of letters and transmits numerous official telegrams, which involve expenditure to the Administration, without being a source of receipts. Therefore, to obtain the true result of the working of the posts and telegraphs, we should have to increase the difference between receipts and expenditure with a sum which certainly would be very important, representing the rates of the free correspondences.

The introduction in France of the collecting of money by post offices for bills of exchange, receipts and commercial bills, had been asked for on various occasions. This service worked already successfully in Germany, Switzerland, and Belgium.

In 1879 the results of the reducing of rates were already known; the first measures required to strengthen the postal work had already been taken; the only thing to fear was, that, inaugurated at a moment when a considerable increase in correspondence would suddenly be produced, the new service might interfere with the various machinery of the Administration. Circumstances appeared to us favourable to satisfy the wishes of the public and to submit to the Chambers the result of careful considerations, by proposing to it to establish amongst us this collecting of money, which renders such services to, and has succeeded so well, with our neighbours.

It has not been our intention to enter into competition with private enterprise, but, on the contrary, to come to its aid wherever its means of action were insufficient; we wished to give to commercial transactions a new co-operation which the intervention of the post alone could obtain for them in a complete and general manner.

If the collecting of invoices and bills of certain importance could be done on reasonable conditions in towns, the expenses, however, became considerably higher when this referred to small sums, which had to be paid in certain rural parishes; the negotiation of such bills was therefore nearly impossible.

We knew, moreover, from the example of what goes on at our neighbours, that on this point the post was able to satisfy the wants of commerce.

The post, in fact, by having its offices distributed over all parts of the country, and by its letter carriers who pass every day through the smallest hamlets, possesses beforehand all the necessary means for carrying this out. Its devoted and industrious staff offers to the public the required guarantees of safety and efficiency. At the same time, by undertaking the duties of collecting money, it really does no more than extend the service of money matters, which of late years has become of considerable importance.

Constant practice, moreover, shows that the post is by nature designed to undertake the collecting of money. Before the post was officially charged with this work a large number of commercial houses and bankers already made use of our postmen in all localities, where it was impossible to do this otherwise, without sustaining considerable expenses.

We know from an enquiry, made in 1878, that the total amount of the sums thus collected by the letter-carriers was not less than 47 million francs. There were serious objections to allow of such important work being carried out in an irregular manner, beyond all control, and we have thought it prudent, without depriving commerce of the means of effecting these collections through the agency of the post, to put this service in better order, and to bring the postmen under the full responsibility and supervision of the Administration.

Prompted by what is done in the countries where the post undertakes the collecting of money, for invoices and bills of exchange, and after having considered the various systems now working, we have given our preference to that which has appeared to us to be the most simple, and which will introduce the least complication in the numerous books kept by the postal officials. This system is very similar to that which has been adopted in Germany, Switzerland, and in the relations between those two countries. The depositor himself inserts the bills, the amounts of which have to be collected in a registered letter addressed to the post office of the district in which the debtor resides.

This office is thus directly charged with the collecting of the money; the amount received, after deducting the rate, of which we shall speak later on, is changed by the postmaster into a post office order in the name of the depositor. Thus one office only is in reality charged with the collecting; the forwarding office has only to transact the ordinary work, viz., the sending of a registered letter and the cashing of a post office order.

The rates for each of these transactions are:—A registration fee of 25 centimes; a deduction of 5 centimes for every 20 francs in favour of each of the officials charged with the collecting (postmaster and letter-carrier), with a maximum of 25 centimes for each of them; and, finally, the rate for the post office order of one per cent. This manner of proceeding assures quickness in the transactions; only very little more work is thereby thrown upon the staff, and it avoids thus the increase of expenses which the deposit of bills without security would entail, and by which both the terminal offices participate in the work of collecting, and sometimes even the intermediate offices.

At the approach of the days of falling due, any obstructions at the counters of the offices, which is inconsistent with the quickness of postal work, is thereby avoided; at the same time, owing to the commission deducted from the total amount, both the postmaster and the postman charged with the receiving are interested in the success of the collections; they are certain of a remuneration in proportion to the service rendered, without charge, either to the Treasury or to the depositor.

The law of the 5th April, 1879, had contented itself with laying down the basis of the new organisation and determining the essential arrangements of it, leaving to the Government the power to extend it in a manner compatible with the difficulties of our work, should further developments appear to become necessary.

When an Administration, burdened as is the Postal Administration, adds a new load to its ordinary work, it is of course impossible from the very beginning to proceed in a general manner, and to create all at once a service which did not exist. It is necessary to grant it the power to organise it, and to extend it progressively.

In order to avoid the difficulties which the collecting of protestable bills could involve, the post ought to receive, in the beginning, only bills payable without costs. For the same reason we were authorised to organise the new service only successively, by taking in account local circumstances, and in such a way as to reconcile the work of the postal service proper with the new obligations to be imposed upon it.

At the beginning the post only undertook the collecting of bills, the total amount of which did not exceed 500 francs; but we had the power to increase this maximum later on, by means of decrees inserted in the *Bulletin des Lois*.

Making use of the freedom which the law granted us in this respect, we have hastened to extend and to complete the new service as soon as we have thought it possible to do so without interfering with the regular working of our department. Thus the decree of the 10th May, 1879, had temporarily excluded Corsica and 40 important towns, where some difficulties might have been met with at the beginning; since the 28th June of the same year, we have reduced to six the number of towns excluded from the benefit of this law; the decree of the 9th July following in doing away with the last exceptions, extended it to the whole territory of continental France and Corsica. Finally, a decree of

* The Amount of subventions paid since the 1st July, 1880, by the Department of Posts and Telegraphs for the maritime service with Algeria and which previously was paid by other departments.

the 31st March, 1880, allowed of accepting bills payable in towns of Algeria.

The new service has been working from its beginning with the greatest regularity. From the 15th June till the 31st December, 1879, 425,981 bills of exchange, &c., amounting to the sum of 9,564,298 francs, were deposited at its counters.

The sums received under this head for the profit of the Treasury amounted already to 96,616 francs, and the deductions in favour of the postmasters and postmen attained 43,494 francs. These results were easily obtained, without hesitations, without inconvenience to the general progress of the service.

Wishing to profit by the advantages of the new law, the public did not leave off demanding the extension of it; many chambers of commerce made themselves specially the organs of these wishes. We were asked to raise the maximum of the sums to be collected, and to admit protestable bills. We have not hesitated to profit by the power which gave us the 10th article of the law, and by decree of the 3rd January, 1880, and on our proposal, the maximum of sums to be collected was raised from 500 to 1,000 francs. A more recent decree of the 19th June, 1882, has raised this maximum to 2,000 francs.

We have preoccupied ourselves at the same time to allow the public to entrust also to the postal service the care of collecting protestable bills. The study of this question has made us cognisant with various systems successfully used in different countries.

The Belgian law authorises the officials of the Postal Administration in parishes where there is neither notary nor broker's man, to draw up the protests themselves; in parishes where, on the contrary, a public officer is to be found, except he be prevented or absent, the protests are drawn up by him. In the first case, moreover, the protests are not made by the postal officials unless the bill is payable in the parish itself in which the post office is situated.

The official charged to draw up the protest, merely states on the document the reasons for refusal to pay; and if the debtor has not signed, the inability or refusal to sign is stated.

In Germany, the powers of the postal officials are not so great. They have in no case the right of making the protest. When the sender forwards a bill to a post office, he may, in case the addressee should refuse to pay, request the post office to give an order to a public officer; it is sufficient to write on the back of the order the words "To protest at once," without being required, however, to designate by name the public officer. If payment does not take place, the bill is then handed over to a notary or broker's man, and this person makes the protest according to the law. If there is no public officer in the district, the post office forwards the bill to the nearest office with a request to hand it to one of the public officers of the parish.

This system is easily applied, because of the delay fixed for the drawing up of the protest by the laws of that country. In Germany the protest can be made even on the second working day which follows the day of falling due of the draft. This latter system is still in force in Switzerland, but it is contemplated to authorise the Swiss postal officials to make the protests themselves.

Neither of these two systems was immediately applicable in France. In the first one, the protest to be drawn up in certain cases by the postal officials, raised serious objections; it would have been necessary, in fact, to trust the drawing up of a document, which should present all the guarantees of authenticity, to women in charge of post offices and, above all, to letter-carriers of less than 21 years of age; this mode of procedure, moreover, clashed with our customs.

The German system, which is easily applied in countries where the time allowed for protesting is much longer than that which is fixed by our code of commerce, seemed at first sight to present certain difficulties.

The combination which we have adopted also consists of always having recourse to the intervention of a public officer, but the rules have been prepared with particular care, and have foreseen the different operations to be carried out. With the view of rendering the formality of protesting unpaid bills more easy in all districts, the Keeper of the Seals, whose co-operation we naturally had to request, proposed, in the beginning, to extend for all bills the delay of 24 hours fixed by Article 162 of the Code of Commerce.

However, after mature reflection, it has appeared preferable in this question not to introduce any modification in the existing laws. We have been able, moreover, by making use, when necessary, of the express, to assure the protest of unpaid bills at nearly all points of the territory, except in Algeria and in some islands along the coast, where the protest of unpaid bills could not take place within the legal delay of 24 hours after the falling due; moreover, the greater part of the districts which have remained outside the new service, are destitute of all commerce, and it is only very rarely that there are bills to recover, much less to protest against.

The service of the collecting of protestable bills has been inaugurated on the 1st February, 1884, in the chief towns of districts of Algeria, where there are at the same time a post office and a broker's man.

The law on the collecting of protestable bills came into force since the 1st July, 1881. A regulation of Public Administration, dated the 6th February, 1881, has fixed the rules to be followed between the public and the Administration or between the public and the officers charged with the carrying out of the protest. 3,172 broker's men and 421 notaries have agreed to execute the

protests without previous deposits; so that the protest is made sure of in this manner in 20,000 parishes. In all the other parishes it can be done with previous deposit. Under these conditions we thought the time had arrived to complete the improvements introduced in the service of the collecting of bills, by reducing the rate.

The law of the 5th April, 1879, had fixed at the uniform rate of one per cent., the rates to be charged for changing the amount received into a post office order. The costs resulting therefrom were very small when they referred to sums of a relatively small amount—they often were less than the commission which a banker would have charged, and did not even amount to the rates adopted by Switzerland and Germany. But when the total amount of the bill to be collected amounted to a relatively important sum, the collecting rate became too high. We have been able to ascertain that the greater portion of the amounts entrusted to the post were less than 50 francs, and that the number of those which exceeded this sum was relatively small.

On our suggestion, therefore, the law of the 17th July, 1880, on the collecting of protestable bills has reduced to half per cent. for those exceeding 50 francs, the proportional rate for the post office orders made out in repayment of the collected bills.

The reduction of the rate fixed by the law of the 17th July, 1880, has been applied since the 1st August of that year and, far from causing a diminution in the receipts, it has augmented them to such an extent as to prove that our expectations were justified.

(To be continued.)

THE NATIONAL CONFERENCE OF ELECTRICIANS, PHILADELPHIA.

(Reported specially for the "Electrical Review.")

(Continued from page 371.)

Prof. ELIHU THOMSON: Mr. Chairman, I have been at work on dynamo machines for a long time, and my experience teaches me that some of the statements made are not correct. For example: there is a factor that has been omitted in regard to the extension of poles of magnets. We have a figure showing an extended pole piece, under which an armature is revolved. It is stated that the lines of force find it easy to go this way (arrows, fig. 5). I do not think so. We find, on examining the machine during its motion, that the armature itself is a magnet of an opposing character, that it produces poles which are opposing the magnetism of the field poles, and if the armatures are of uniform size and section throughout, that the magnetism developed here in opposition to the field of magnetism will be the same as here (indicating). Consequently, you have an opposing force to the field-magnet at this point greater than it would be there (indicating), and, consequently, you have again produced a loss of magnetic force by going this distance.

Another fact, and this is what may happen very readily, there is a field running up the side of the magnet and turning in again. By the extension of the poles, carrying your magnet along here, you will obviate to some extent that difficulty.

Then we had the statement made that one set of magnets is better than two opposing sets, as in certain well known forms of machines. I would like to take exception to that also, and for very simple reasons. Take away one magnet and you give every chance for this kind of action, and taking into consideration the fact that the armatures are crossing the magnetism of the field-magnet when it is revolving, it becomes extremely simple to see. Place another magnet here (a, fig. 4), and you force the magnetic lines through the armature, and you consequently have a much better machine. That leaves out of consideration the fact that

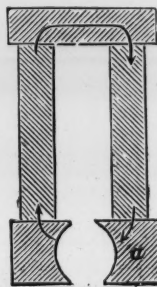


Fig. 3.

you have a small plate of material (of only two and one-half or three inches thick in case of fig. 3) in proportion to the magnet, which has enormous reaching power, if you may choose to call it so. We have an iron plate here (a, fig. 3). Now, taking into consideration again the enormous currents that are developed in that armature opposing the magnetism; that it passes the magnetism of the field down through the armature, you see what a

short-circuiting of the field of the armature is made when the iron plate is put in any sort of proximity to the ends of the field poles.

Again, take the form of the machine where we have the field-magnet in two pole pieces, and we bring the iron down the side to close the magnetic circuit; we bring the piece out in that manner (fig. 6). The question arises (I have not investigated the subject fully) whether the loss by magnetic short-circuit will be made up in part by the external magnetisation of the coil upon the iron in this direction (dotted lines). In other words, by removing the iron, not too far away, and again not too near,

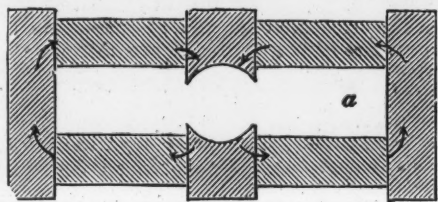


FIG. 4.

whether you do not get an external magnetisation of the iron lying close up to the exterior of the coil, which would make up for part of this loss by short-circuiting from proximity of iron to the field pole.

With regard to the use of long or short magnets in the dynamo,

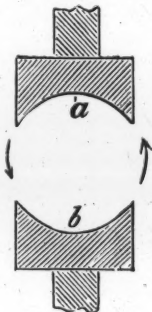


FIG. 5.

if we take into consideration what I have just stated in regard to the magnetising power of the armature, it will depend upon the diameter of the armature, and the length of the magnetic conductor that is in the armature. Assuming the armature to be made up of radial bars or even discs, the length of magnet you will have to employ will depend upon the opposing magnetic effect of the armature. And I may say also, to the distance between the field-magnet and the armature. If you wish to get reaching power or depth of field, in order to reach any distance through the armature, the iron being far away, you will have to use long magnets. If you have an armature which has long projections making an approximate contact, you can use much shorter magnets with equal results.

In regard to the use of steel magnets: It is well-known that steel in no condition can accept as much magnetism as soft iron, and it is also well known that if you harden the exterior of a magnet having soft-iron interior, that the radiation to the soft-iron interior of the magnetic lines will cause a short-circuit of magnetism through the interior of the magnet. So I do not think we can look for any improvement over soft-iron for field-magnets. There are many other considerations that might be noticed which show economy lies in using soft iron only, where we wish to get the greatest available magnetic strength.

I cannot agree with either of the gentlemen who preceded me in the statement that there is dead wire in the Gramme armature, or in any other armature that encloses a magnetic circuit. If that was the case, then all wire upon bobbins would be dead wire. We could not produce a dynamo machine which had bobbins in it (for what is the Gramme ring but a series of bobbins), which when they pass the field poles—those bobbins are magnetised there in that manner just as they are in the old Holmes and Alliance machine—when they pass from the position where they include the greatest number of lines of force, pass from the position of saturation to the position of less saturation; they go over to a position where the saturation is reversed. What suggests the reason that the outside of the wire would be more efficient than the inside wire is simply because, as I look at it, there is a tendency that is unrestrained, for the armature to kill itself while it is passing at this point (indicating). There is a tendency of the armature to magnetise the magnet, making a closed circuit on the inside of the ring, which diminishes the effect of it on this wire. However, this closing of the magnetic circuit on the outside of the core causes the field magnet to lose control of the direction of lines of force. This closure of the circuit on the inside of the ring, however, is simple and easy to

take place, because here the iron is practically removed from the powerful control of the field magnet, and the coils are where they can act as magnet coils to close their own circuit. How can we increase the efficiency of such a machine? Evidently we can prevent that closure by putting some more magnetic material there.

There is an effect in such machines to which attention has not been called. It is that we can take the same sizes of wire applied to a larger machine and exhibit a real and theoretical increase of efficiency. I hold, however, that theory, when it is true and complete, always coincides with true and complete practice; there is no intermediate stopping point. If you take into consideration every variable, you are bound to arrive at the complete practice; you cannot have one thing theoretical and the other practical. It has been proved mathematically, and it is very easy to go over the ground, but I will not take your attention now, that if we use the same size of wire on armature and field we have the power of the machine increased as the fourth power of its linear dimensions. But if we attempt to apply that in practice, we find this: that the surface of the machine clearly increases as the square of the dimensions, whereas the cubic capacity—in other words, its power to retain heat—increases as the cube of its dimensions. The result of that is, that in a large machine you will have to provide a greater amount, proportionately, of cooling surface, or enlarge the size of the wire. The power of the dynamo run for series lighting (I may say I have only determined it approximately) increases as the cube instead of the fourth power of the linear dimensions.

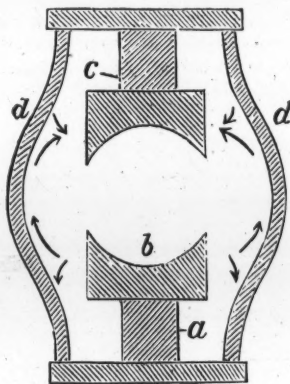


FIG. 6.

In the study of the Gramme armature and its method of commutation I think we have yet to learn a great deal. I cannot see any reason why in the Gramme armature during the commutation there should be any loss at all. Let us figure the ring and study the action of commutation. A coil goes out and comes upon the commutator, passes it and returns, and so on. I hold that the period of contact is such that if the brushes upon these segments are properly arranged there will be no loss; in other words, the time of contact that must exist between these two segments and the brush will be the time that it takes for the coil to lose its current; the commutation must not occur at any other time than when the coil is ready to lose the current and acquire current in the opposite direction of the same amount it is to take when the break shall be made. I do not know that I have made that perfectly clear, but I will go over it again. If the contact remains for a sufficient period to allow the coil to lose its current and the commutation is only being made while it is running down in electromotive force, and continues until the current rises on the other side, until it is fit to go into the circuit; in other words, until it just conducts the current that the other side demands, you will have no loss from commutation. Make it just at that period, and where is there any loss?

In regard to the resistance of armature coils, I think there is an effect that is generally omitted in considering dynamo machines, and it is this—that we cannot consider the measurements of the resistance of the armature at any time as the working resistance. We cannot measure it in any position and let that be taken as the resistance of the armature coil when it is working. Why? Because in any dynamo that furnishes us continuous currents we will have this condition sometimes existing. That is, in the Gramme we have constantly two series of coils; in the Brush, two series of coils, put in multiple arc at times. If you measure the machine while not at work you take it for granted that the current when the machine is running will be equal in those two branches? Will it ever be equal in those two branches? The energy developed by that armature will depend upon whether the current divides equally for the time being. In other words, whether the ring is equally balanced, or whether the brushes are of equal temperature, or whether the armature is put at the centre of the field. The wire will become more energetic if it is nearer the field pole than the under side, and the effect will be that you are sure to displace your commutator brushes. More current will pass through one side than through the other, and you will have more heat developed in one than in the other, and you will not have a perfect dynamo. You will have more energy consumed in that dynamo; and I may say that there is not a

machine that I do not regard as coming under that condition. You measure the resistance of the machine when still, and you will not have the same resistance when running it, because the currents do not divide as in still resistance.

That is about all I have to say in regard to the subject under discussion, except that if I have an opportunity I should like to call attention to a number of other matters that affect the working of dynamos. These matters have been derived from studying dynamos and making very many types of machines and experimenting with them, my whole time being almost entirely devoted to their study.

THE PHILADELPHIA ELECTRICAL EXHIBITION.

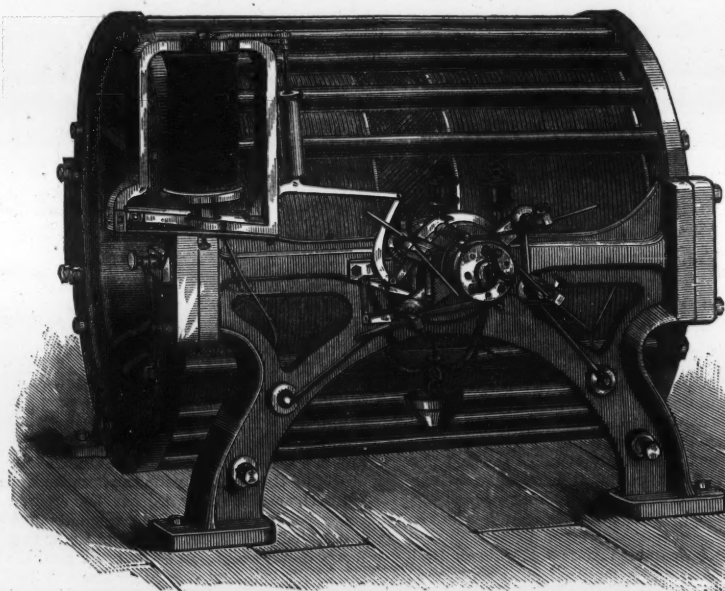
THIRD NOTICE.

THE Thomson-Houston Electric Company.—The system of lighting exhibited by this company comprised dynamos, regulators, arc lamps, switches, cut-offs, incandescent lamp distributors, central station switchboards, &c., together with a number of specialties exhibited publicly for the first time at this exhibition. It will be our purpose to describe the various parts of this system, whose growth in the United States has been very rapid, there being about 10,000 arc lamps and 500 dynamos in use; while in the Canadian provinces it seems to be the only arc system that has met with much extension.

The Thomson spherical armature dynamo which was partly described in the *ELEC. REV.* for March 31st., 1883,

ordered. The current of 9.6 ampères is the usual standard. Briefly, the machine has two field-magnet coils, which are virtually but one coil, and they are wound so as to enclose the armature core as well as the field-magnet cores. Virtually, therefore, the armature revolves inside the field coils, and its core is directly polarised by them. The form of the armature being, when wound, that of a sphere, conduces to this disposition of the field coils, which are themselves cylindrical coils. The foregoing disposition was adopted by Mr. Thomson as of value in causing the field magnetism to pass through the armature core, and as increasing the proportion of wire directly subjected to magnetic actions, while the form of armature is such as can be readily constructed and wound; gives small air resistance, good balance, and sufficient ventilation of the wire during revolution. The armature-winding is the Thomson-Houston method, involving the employment of but three coils or sections of wire, three of the terminals of which are connected together at a common joint, and the three free ends connected singly to separate segments, three in number, in the commutator. The segments are peculiarly mounted, and are removable and replaceable, as will be seen from the details of its construction. The commutator brushes are four in number, and are regulable in pairs, as will also be described.

Referring now to the figures, the field-magnets consist of two hollow iron castings, M, M, of the form shown in fig. 1, partly in section, and having flanges,



DYNAMO-ELECTRIC MACHINE WITH THOMSON'S SPHERICAL ARMATURE.

embodies some of the joint inventions of Elihu Thomson and Edwin J. Houston, and further radical improvements of Elihu Thomson. It furnishes current for the running of arc lights, lights in series and in multiple series, motors, motor-generators, and incandescent lamp distributors, giving to the line at all times a standard current due to the use of the automatic regulation peculiar to it. It is constructed of various sizes, the normal capacity varying from one arc light to sixty in series. The work of each machine may be changed from short circuit to full load, or inversely, quickly or gradually, while the line current is restored and kept to its normal standard by the automatic regulator. Variations of driving speed are, in like manner, compensated for by the regulator, provided that the speed does not fall below an amount necessary to maintain the current under any given external resistance.

The winding of the machines is varied during construction so as to adapt them to the production of the standard currents of 4.8 ampères, 6.3 ampères, 9.6 ampères, 20 ampères, 30 ampères, and above, when so

F, F, extending therefrom. At A they are shaped to a nearly hemispherical outline. The magnet coils, C, C, are wound upon their exteriors, and a brass flange, b, b, keeps the coils in place. The space, A, A, between the opposed faces of the castings is nearly filled by the spherical armature, the shaft of which passes transversely across, and is borne in bearings indicated in fig. 2. The bearings form part of the side frame, F¹, F¹, as shown, and to which M, M, are bolted. The large flanged portions, F, F, are united magnetically by a series of bars of soft iron, B, B, usually 18 in all, placed outside the coils, C, C, and at a short distance therefrom. The portions, F¹, F¹, besides sustaining the bearings of the shaft, are shaped as seen in the above illustration, to afford feet for the machine. In fig. 2, P is the driving pulley, D is an air jet mechanism carried concentrically with the shaft, and K, H, H, are the commutator and brushes as placed on the machine. These will be referred to in detail further on. The armature is constituted as follows:—The armature core consists of a hollow iron shell of the form of an oblate spheroid, mounted centrally upon the shaft, as seen in fig. 3, the

shaft passing through the axis of the spheroid. Two thin flange castings, *a, a*, are placed upon the shaft and keyed to it. They are made of fine iron, and serve to

FIG. 1.

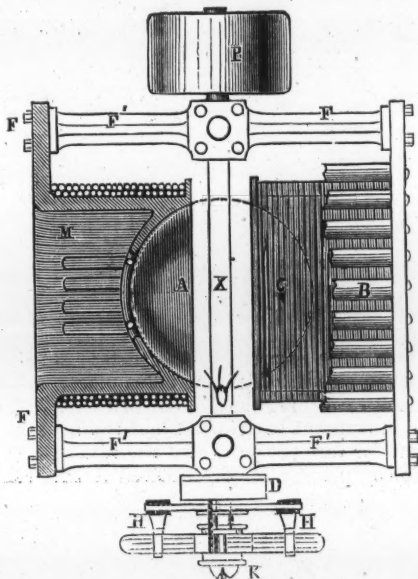
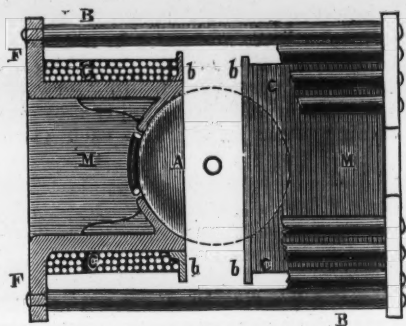


FIG. 2.

give support to a number of cast iron bridges, *d, d*, which are insulated from the former. There are generally 12 bridges, whose ends are carried in circular

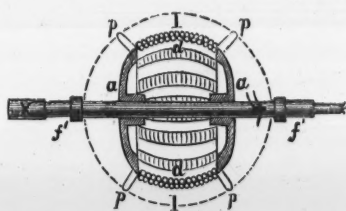


FIG. 3.

grooves in the internal rims of a , a , as shown. The width of d is nearly $\frac{1}{4}$ of the circumference of the flange, a , and figs. 4 and 5 give an idea of its usual

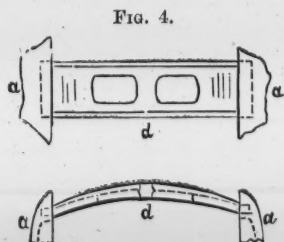


FIG. 5.

form. Outside of the bridges, d, d , is wound a quantity of well annealed soft iron wire, 1, 1, sealed by heat and shellaced.

The amount and depth of wire used varies with the capacity of the machine, and completes the outline of the armature core. Pins, p, p , of wood are inserted into the edge of a, a , so as to serve as guides in winding the armature. The whole core is covered with layers of insulating paper, and is then wound with the insulated wire. The pins, p, p , are so placed as to divide the circumference of the flanges, a, a , into six spaces for wire. Sometimes additional pins are placed at I, I , to correspond with those at p, p . The coils or helices of the armature are only three in number, and cross one another at the polar portions of the core, where the shaft enters. To secure electrical equality, as well as mechanical equality of the three coils or helices, the method of winding is as here stated:—

1. The first half of the first coil is wound. 2. The first half of the second coil is wound. 3. The whole of the third coil is next wound. 4. The last half of the second coil is wound. 5. The last half of the first coil finishes the winding.

The result is an approximate sphere of wire and iron. The coils are thoroughly insulated and interwoven with tapes wherever advisable to keep the wire in place. Four bands of hard brass wire, U, U, U, U, are

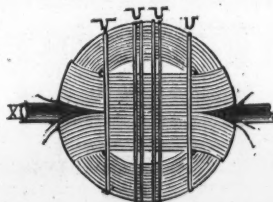


Fig. 6.

applied to the exterior, as shown in fig. 6, and hold the coils in place while revolved. As wound, the coils have six terminals, three of which are joined together, and the remaining three are carried (usually through the hollow shaft) to the separate segments of the commutator. The manner of winding is such that the three ends joined together are from the inner layers of the coils or the beginning of the winding. The coils are begun at positions 120° apart, upon the core. By this mode the highest differences of electric potential are found only upon the outside wires, such conditions being very favourable to retention of insulation under all conditions. The impulses generated in the armature correspond in the three coils at a sequence of 120° of revolution. This gives, with the small number of generating helices connected as described, a continuity of effect in the delivered currents.

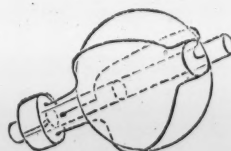


FIG. 7.

Fig. 7 shows in a diagrammatic manner the winding and connections, one half turn only of wire in each coil being figured. The commutator in the Thomson machines consists of a copper ring slit into three segments of 120° extent nearly. Each segment is independently mounted upon a metal frame which gives the segment its position.

Figs. 8 and 9 show the form of the copper segment. The piece, *e*, *e*, furnishes the means of attachment to its supporting frame, *f*, figs. 10 and 11. The segment as shown bears firmly upon *f*, at points adapted therefor. The frame, *f*, is carried in turn upon rods, *r*, *r*, upon which it is strung. The rods, *r*, *r*, are in turn mounted in insulated holes in metal flanges covered all over with hard rubber or other insulator. This construction is seen in fig. 12. The flanges are marked; *g*, *g*, and are shown in partial section, the upper half being sectioned. The rod, *r*², has a binding post for the attachment of one of the wires from the armature.

The other wires are attached in like manner to other rods, which, of course, are respectively in contact with other segments of the commutator. The mounting of

pair form angles of approximately 60° , but change their angle during regulation. The setting of the brushes is automatic, and their carriers are therefore made movable.

There are two systems of movement that will accomplish the desired regulation. They may be designated "forward regulation," and "backward regulation." Both have been applied to these machines, but the latter is that now generally used. In "forward regulation," fig. 14, the brushes are simply moved forward while retaining their relations to each other, as in

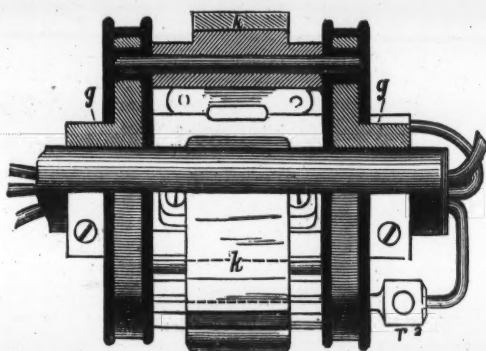
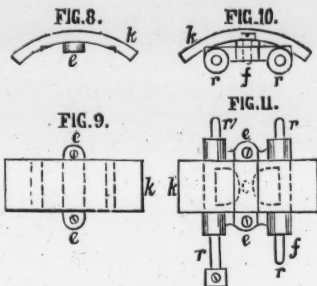


FIG. 12.

the segments thus provides a free air space all around them, gives extended surfaces for insulation and nowhere does the metal of the supports approach near enough to facilitate leakage.

The fig. 13 shows diagrammatically the relation of

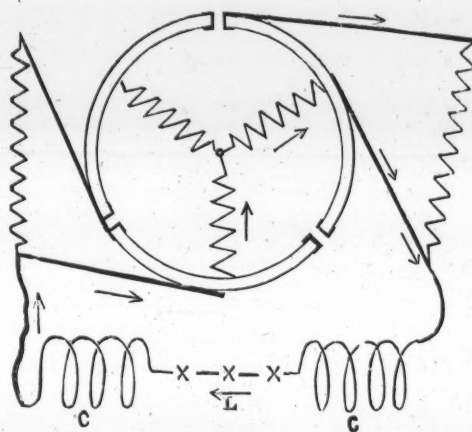


FIG. 13.

dotted lines, so as to preserve a constant current when a diminished circuit resistance takes place.

In "backward" regulation the brushes, 2, 2, fig. 15, receive a movement backwards, and the brushes, 1, 1, a movement forwards at one third the rate of movement of 2, 2, to compensate for diminished circuit resistance

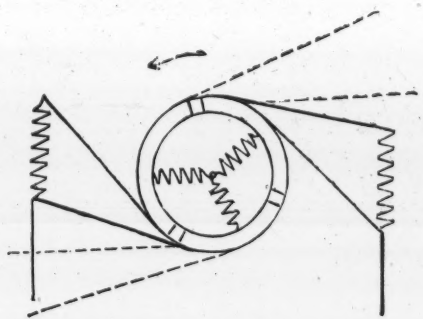


FIG. 14.

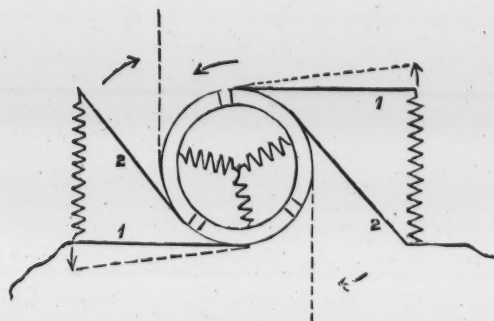


FIG. 15.

the armature coils to the segments, and the brushes applied thereto, the field-magnet coils, C, C, and circuit, L. There are two pairs of brushes used, one pair positive, and the other negative. The brushes of each

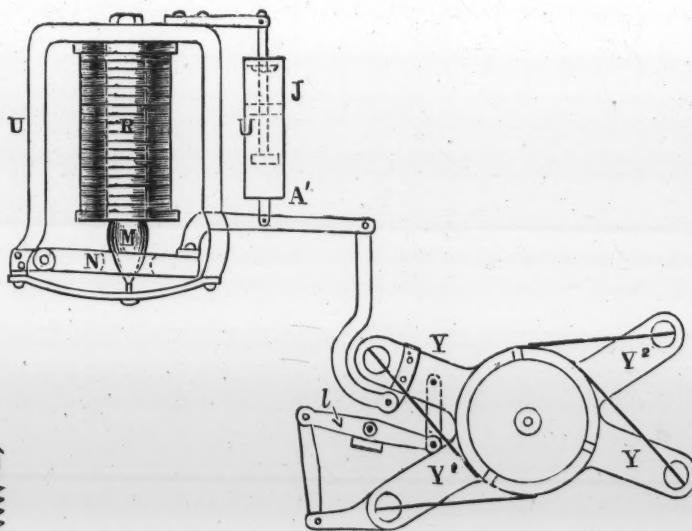


FIG. 16.

or increased speed of running. In both cases of regulation the position of the commutator and brushes is originally set so that only a small spark of rupture occurs when the segments break contact with the leading brushes. The connections of the regulator are shown in fig. 16. The motor regulator-magnet is constructed of a stout U-shaped frame carrying a coil and core, R, whose pole, M, is paraboloidal; the armature, N, has a large perforation, whose edges are rounded, moving over the pole, M; the armature is swung upon its pivots, as shown, and is situated between the legs of U, U, a construction which relieves undue strain upon the pivots,

and the armature, N, does not change its distance from the legs. A dash pot, J, checks too sudden movements. The form of magnet just described was constructed by Mr. Thomson for obtaining a uniform attraction at different positions of the armature with constant current, and has been extensively applied by him in lamp construction, and many other devices, in modified forms.

The motion of the regulator arm, A', is given to the yoke, Y, Y, of the commutator by a connecting link seen in the figure. The yoke, Y, Y, is made to impart movement to Y², Y², by an intermediate lever, l, and appropriate connecting links. The brushes are, of course, thoroughly insulated from the carrying yokes.

The regulator magnet, R, is seldom so sensitive to current fluctuations as to be used by itself for regulating the brushes. It is therefore made to respond to the action of a sensitive controller magnet placed in a suitable protecting case near the machine.

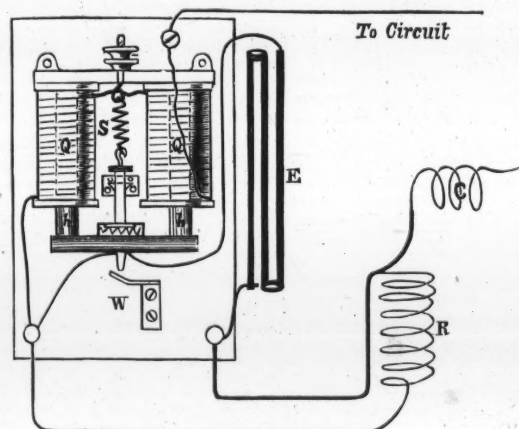


FIG. 17.

Fig. 17 shows the controller magnet as made of two hollow helices or solenoids, Q, Q, placed side by side and exerting axial attraction upon two yoked cores, h, h, suspended as shown by an adjustable spring. The weight of the cores, &c., is such that when a standard current flows the attraction will be insufficient to lift the cores, but is assisted a little by the spring. The yoke of the cores, h, h, carries a silver contact piece resting, when out of action, upon a second stationary piece, W, suitably placed below it. A resistance, E, of carbon rods is connected around the contact, and the contacts form, when closed, a shunt of small resistance around the carbon, E, and the regulator magnet coil, R. The coils, Q, Q, are permanently in circuit. Slight fluctuations of the line current are recognised by the controller so formed, when once adjusted, and a closing and opening of its contacts at W takes place in accordance therewith, the result being that the magnet, R, is shunted more or less, or for greater or less periods, and acts to maintain the commutator brushes at those positions corresponding to the standard line current to which the controller magnet has been set. The controller is virtually a delicate relay for counteracting the variations of line current by its control of the motor magnet, R. The results are, that machines can be short-circuited or their external work varied, or variations of driving speed occur, and a standard current still be maintained. Unsteady power does not injure the steadiness and uniformity of the arc lights supplied.

A striking feature of the Thomson apparatus is the air jet or blast applied to the commutator. Its purpose is to control high potential differences between the segments, and to permit the free oiling of the commutator to diminish wear. By its use machines giving over 2,500 volts from only three segments and three armature coils are successfully operated. It is well

known that in high potential machines little or no oil can be applied to the commutator, and that in many cases the potentials are divided by the use of two, three, or more commutators in series.

Thomson's air blast is based upon the discovery by him of the fact that a jet of air of small amount could effectually break and disturb any line of conducting particles tending to bridge the commutator slots, and so cause discharges termed "flashing" or "arcing over the slots." Small jets, T, fig. 20, are mounted directly opposite the tips of the commutator brush of each set. When the slot in the commutator is passing the tips of the brushes a puff or jet of air enters the slot from T and effectually insulates it. The jets are repeated at every slot.

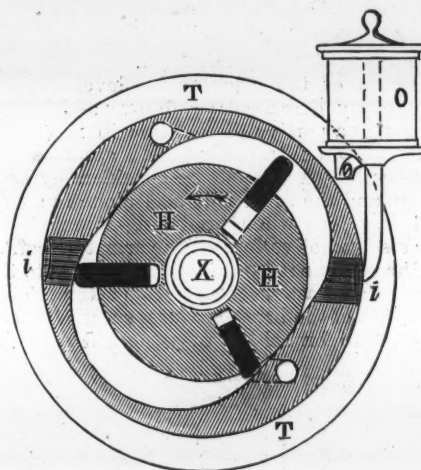


FIG. 18.

The inventor has devised a simple mechanism for furnishing the puffs at the proper instant. A small rotary positive blower, figs. 18 and 19, is mounted on the journal box at the commutator side of the machine and driven by the machine shaft, X, passing through it. The case is circular, but is bored out to a nearly elliptical outline interiorly, in which elliptical space a circular hub, H, H, is revolved by the shaft, X. The hub, H, H, is not firmly fastened to the shaft, but is merely driven loosely by a key and spline as usual in such cases.

FIG. 20.

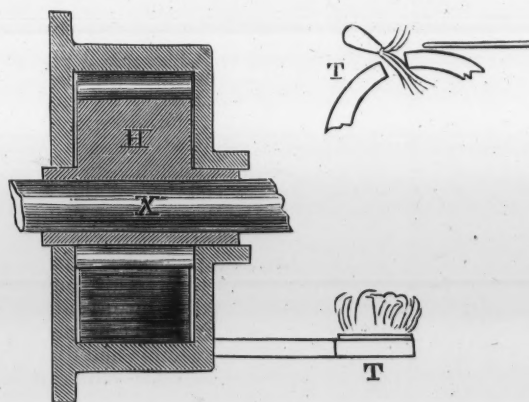


FIG. 19.

The hub is slotted as shown for the reception of three hard rubber or ebonite wings, serving as rotary pistons, and corresponding to the commutator slots in such way that they are giving their maximum action in propelling air at the moments when the commutator slots pass the brushes. During rotation air is drawn in at i, i, the inlets, consisting of numerous small perforations in the case, usually covered by wire gauge screens. The air is ejected from T, T, which

openings are in communication with those ends of the crescent-shaped piston spaces towards which the rubber pistons move. An oiler, O, is affixed as shown, and introduces small quantities of oil at *i* from time to time. In fig. 19 T shows the jet tube, the jet proper being a thin slit in the tube a little longer than the commutator segments are wide. The jets, or puffs of air, match perfectly the times of passage of the slots in the commutator, and can be made of sufficient vigour to secure perfect insulation. The wear of parts is very small, and the rubber pieces have been examined after over a year's use without disclosing any considerable wear. As a result of the use of the air blast, the Thomson machines can be effectually run with a steady stream of oil falling upon the commutator, and the segments of the commutator being mounted in *free air* without carbonisable material in contact with them, no fear of short circuits of armature coils by leaky commutators need be apprehended.

The action of the machine in developing current may be briefly described as follows:—The armature helices act for a portion of the time in multiple arc of two coils, as when traversing field spaces where the impulses generated in them are considerably below the maximum, and the third coil acts alone in series with the said two coils when producing its maximum impulse or electromotive force. The armature coil system being a three branched conductor, gives rise to the condition just stated as a necessity of its action. The mode of application of the brushes causes successive transfers from branch to branch, as they succeed each other in

machine running 34 full lights, gradually diminished to a short circuit, will elucidate the matter. It is to be understood that in *practice* such a machine is rarely used with less than half its number of lights in circuit, though capable of being run indefinitely on short circuit. Thomson "M" dynamo—34 arc lights, 26·2 H.P.; 30 arc lights, 23·8 H.P.; 25 arc lights, 21·3 H.P.; 20 arc lights, 18·6 H.P.; 15 arc lights, 16·0 H.P.; 10 arc lights, 13·2 H.P.; 5 arc lights, 10·1 H.P.; 1 arc light, 6·5 H.P.; short circuit, 6·0 H.P. The power stated includes air resistance and friction of all kinds; being the total energy supplied.

In "forward" regulation, fig. 14, there are different conditions set up. The action is then analogous to that of setting the brushes of a Gramme or Siemens machine forward, and depends upon the existence of counter electromotive forces in the coils of the armature to effect an adaptation to variations of circuit resistance. Unlike the Gramme or Siemens, such setting forward of the brushes *does not* in the "three branched" system involve short circuits of active armature coils, because the time of contact of two successive segments with the positive brush, for instance, is so chosen in the original setting of the brushes, as to permit simply a transfer of current to be accomplished from a coil that is leaving, to the branch or coil that succeeds it. This transfer is not instantaneous, and varies in time inversely with the strength of the magnetism of the field magnets relative to the magnetic power and self induction of the armature coils. In either case of regulation, speed variations

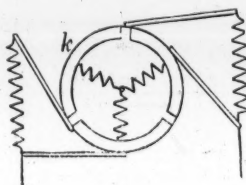


FIG. 21.

electromotive energy, or capability of feeding current to the circuit, and these transfers are effected in a time more or less definite. The segments are alternately put into contact with the positive and negative brushes. The angle between the brushes of each pair gives ample time for the transfer of current from a coil that is going out of action to the one coming into action to supplant the former. In certain of the arrangements above described for the brushes, it will be seen, fig. 15, that there exists the apparently anomalous condition of putting a commutator segment just before the coil or branch to which it is the outlet, has reached neutrality of electromotive force or electrical state, into brief contact or connection with both positive and negative brushes of the machine (see fig. 21, *k*). This condition, however, gives rise to no perceptible inconvenience, a fact accounted for by the powerful effect of the field-magnet helices in preserving the volume and direction of flow of current in the main circuit at the moment of the brief contact above referred to. During regulation, called "backward" regulation, the motion of the brushes is such as to enlarge the period of connection of positive and negative brushes and so diminish the electromotive force of the machine. At the same time, however, the total resistance in circuit having been lessened by extinction of lights or removal of resistances, while the delivered current strength is kept the same, the energy evolved in the main circuit falls in proportion, and the mechanical energy expended upon the armature falls in nearly like proportion. The following table, compiled from tests of a

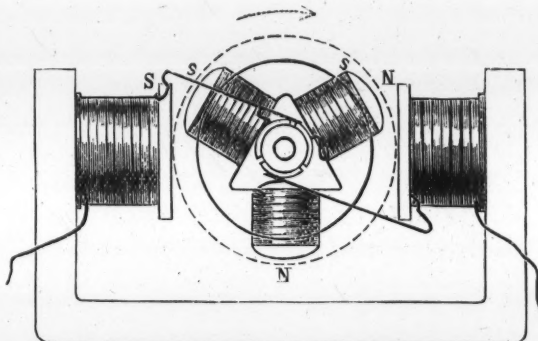


FIG. 22.

are compensated automatically, in virtue of the fact that increase of speed increases the current, and calls into action the regulator. The machine is also a simple and efficient *motor*. In using it for converting energy of current into mechanical energy, the arrangement of brushes is usually similar to the figure 14, but the armature connections are made suitably to cause a forward rotation. Sometimes, in simple machines used as motors and the like, single positive and negative brushes are used, and the slot between the segments of the commutator made to allow overlap to the segments, so that each segment, instead of covering 120°, extends about 160° around the commutator. Simple generators are constructed in like manner.

The *three branch* armature coil system embodied in the Thomson machines above described, has been employed by the same inventor in the winding of cylindrical and ring armatures, for generators and motors. It has also been applied to machines whose armatures consisted of six revolving bobbins, each pair of opposite coils being used as one branch from the common joint or union of the three branches. Small motors have also been made in which the armature coils were simply wound upon three radial spokes or arms projecting from a central hub upon the shaft. Fig. 22 illustrates the motor so formed.

It is evident that many forms of armature core may be adapted to use with the *three branch* winding, or the coils alone may be revolved in a magnetic-field and yield the requisite order of electrical impulses.

(To be continued.)

REVIEW.

Magneto-Electric and Dynamo-Electric Machines: their Construction and Practical Application to Electric Lighting and the Transmission of Power. By Dr. H. SCHELLEN. Translated from the 3rd German edition by Nathaniel S. Keith and Percy Neymann, Ph.D., with very large additions and notes relating to American machines, by Nathaniel S. Keith. Vol. I. New York: D. Van Nostrand, 23, Murray Street.

The original editions of this work were written in a popular style which the author has, under advice, to a great extent abandoned, without, however, sacrificing simplicity of demonstration. Owing to the amount of matter which had to be dealt with, the new edition has been divided into two vols., of which the one under consideration is the first. A material alteration and improvement which distinguishes the present work is the uniform adoption of the Paris Convention units. The translator throughout the work freely criticises Dr. Schellen's theories, pointing out the weak points, but he avoids substituting theories of his own. The book, generally speaking, is really little more than a recent edition of such a work as Gordon's "Treatise on Electric Lighting," though, of course, it is by no means a copy. The usual preliminary chapter dealing with magnetic induction commences the work, and calls for no comment. We next have brief descriptions of measuring instruments, both for mechanical and electrical work. The bulk of the remainder of the work is taken up with descriptions of dynamo machines, the number described being larger than that given in any other book. We notice, however, that the "Ball" machine is only mentioned as "not having yet attained any technical importance." Part XII., in which the theory of dynamo-electric machines is dealt with, the experimental and theoretical considerations of Frölich and of Marcel Deprez are given, the author himself not entering into the question. An appendix, showing the units, wire gauge, weights of wire, apparent resistance of the arc of varying length, &c., concludes the volume. Many of the illustrations are hardly satisfactory, and the practice of printing proper names in italics, capitals, and Roman letters, indiscriminately, is not to be commended. Of its kind the book may be pronounced good, but, as we before stated, it can hardly be looked upon as more than a recent edition of older works, being deficient in originality.

LEGAL.

(Sittings in Bankruptcy, Royal Courts of Justice, before
Mr. REGISTRAR BROUGHAM.)

IN RE S. C. HADLEY.

THIS was an application by Mr. Simeon Charles Hadley, formerly an alderman of the City of London, for an order of discharge. The liabilities amounted to £21,369, and the assets, which were estimated by the bankrupt at £2,328, consisted of book debts, which would not produce the value set upon them. The official receiver had no reason to believe that the bankrupt had committed any misdemeanour under the Act. It appeared from the bankrupt's evidence already taken, that since he dissolved partnership with his brother, about three years ago, he had been engaged in several undertakings, including a contract or concession from the Portuguese Government for the exclusive right of laying submarine cables between England, the Azores, Portugal, and America, also in promoting companies. During this period the bankrupt had not kept any books of account showing what these transactions were. The official receiver also stated that the greater portion of the liabilities of the bankrupt were incurred at a time when he had no capital available to meet them, and when he must have known that his ability to pay the amount depended upon the successful result of his operations. The official receiver therefore submitted that the bankrupt had brought on his bankruptcy by rash and hazardous speculations.

The bankrupt stated that he entered into a contract with Mr. De Braam for laying submarine cables between England, the Azores, Portugal, and America. That was in December last. The purchase-money was £25,000, of which £5,000 was to be paid

in cash and the remainder in shares. He had expected that the profits to be derived from the cable company would be sufficient to pay all his liabilities. The debt of the petitioning creditor, amounting to £3,500, had been incurred in reference to the promotion of the American, British, and Continental Cable Company. The money was advanced for the purposes of the company, and he received no portion of it for his own use. Notwithstanding his discharge, it was his intention to pay his debts. Before he undertook the cable contract he ascertained that a considerable profit was likely to arise from it.

Mr. Registrar Brougham said the report of the official receiver was *prima facie* evidence of the facts, and showed that the bankrupt had engaged in rash and hazardous speculations. The explanations which the bankrupt gave, however, put the case in a more favourable light, as the contract into which he entered seemed on the face of it a beneficial contract, and he did not undertake it until he had ascertained that a large amount of profit was likely to come to him from it. He thought, however, that the failure was to a certain extent due to rash and hazardous speculations, and the discharge was liable to be suspended; but, instead of taking that course, he thought it would be of more advantage to the creditors to grant the discharge, subject to judgment being entered up against the bankrupt by consent, for the amount of the debts.

Conditional order accordingly.

(Chancery Division, before Mr. JUSTICE PEARSON.)

RE THE PHENIX ELECTRIC LIGHT AND POWER COMPANY,
LIMITED.—TUCK'S CLAIM.

THIS case, which came on as an adjourned summons, raised the question whether the executor of the late Mr. Jabez Tuck, who traded as a printer under the title of Tuck & Co., could prove in the winding-up of the above company for a sum of £369 9s. 6d. in respect of printing done by Mr. Tuck between the 12th and 25th of May, 1882, at the order of the promoters of the company, which was incorporated upon the 17th of May, 1882. The items in Mr. Tuck's account, which were dated prior to the incorporation, amounted to about £26. The company had paid an account of Mr. Tuck's for work done after the 25th of May, but had uniformly repudiated all liability in respect of the account now in question. By the articles of association it was provided that the directors might pay out of the funds of the company all costs, charges, and expenses whatsoever incurred or to be incurred in or about the formation of the company, including therein (*inter alia*) the cost of printing and stationery, and might enter into any agreements for providing therefore upon such terms in all respects as they might deem advisable.

His Lordship said there was no reason why the company should not have the benefit of work for which some one else had agreed to pay, and he thought that in so holding he was acting in accordance with the most recent decision of the Court of Appeal. No doubt the promoters were liable up to the 17th of May, and as to the later items it was not proved that the company had authorised the printer. The claim upon the company failed.

NOTES.

Electric Lighting.—The Electrical Power Storage Company has lately carried out an installation at the residence of Mr. Phipps, architect, of 26, Mecklenburgh Square, consisting of 40 Swan lamps supplied by the E.P.S. accumulators. The dynamo is driven by a 1-H.P. Otto gas engine. The same company recently lighted the private residence, at Blackheath, of Mr. Yarrow, the well-known launch builder. We understand this company is making a speciality of temporary lighting, for which its batteries are admirably suited.

The lighting of a portion of the Bank of England by means of 160 20-candle power lamps, carried out by the Electrical Power Storage Company some 12 months back, has given every satisfaction. The installation has worked throughout without any stoppage, and the accumulators, from which the current is supplied entirely, have not been renewed in any way.

The Kinetic Engineering Company has, we are informed, received the order for the underground electric light cables for the lighting up of several of the streets in Greenock under the Provisional Order obtained by the Police Board. These cables will be of three types, namely, the main cable, consisting of 36 strands of copper wire, 1.5 millimetres in diameter; the branch main, consisting of 12 strands of 1.6 millimetres; and the leads for the lamp-posts, consisting of 1 wire of 1.2 millimetres diameter. These cables will be of the

Berthoud-Borel type, insulated with Berthoud-Borel material, and encased in a double sheathing of lead, the two sheathings being separated by a layer of gas-tar. A conductivity of 96 per cent., and an insulation resistance of 1,000 megohms per mile at the ordinary temperature, are guaranteed. The cables will not be laid in any troughs or pipes. They will be tarred, and then laid on a layer of fine sand placed in the bottom of the trench, and covered with the same to a depth of about 4 inches. A plank of wood, or layer of bricks, will be placed over the sand to indicate the presence of the cable to workmen afterwards taking up the street, and save it from injury by their tools. Large quantities of these cables have thus been laid in many of the principal continental towns, and give complete satisfaction.

In connection with the widening of Charing Cross Bridge, Mr. J. L. Beeman, having been instructed by the contractors, Messrs. Cochrane and Sons, of Westminster, to provide suitable lighting arrangements and apparatus for their works, has erected over each of the five stagings a 3,000 to 4,000-C.P. arc lamp, and six incandescent lamps, for use in the caissons about to be sunk under air pressure. The former plant, which consists of five D D Crompton lamps and a Bürgin machine, was operated on Tuesday evening, and gave the greatest satisfaction to all concerned. The 12-H.P. nominal gas engine used for sawing, &c., during the daytime, is the motive power for driving the arc light machinery. The apparatus has been so arranged that it can be moved about according to the exigencies of the work, and will be found of special use when the rivetting of the girders commences.

The Consolidated Company, of Portland, Me., using the Thomson-Houston light, has increased its lights from 40 to 149 during the past year, and will, it is said, reach 250 lights at full prices this year, dating from September 7th. The balance-sheet for the year ending on that date shows net earnings of \$4,885 on a business of \$16,696.

The Thomson-Houston light is in use at Montreal, Quebec, Toronto, St. John and Halifax, and preparations are being made by the Royal Electric Company to light Ottawa with it on an extensive scale, the dynamos to be run by turbines.

A rumour is given currency by the New York *Electrical Review* to the effect that litigation of the liveliest kind will soon be in progress with regard to the invention of incandescent lamps.

The members of the American Gas Light Association, meeting at Washington recently, expressed the opinion "that the electric light scare is over for the gas men." They maintain that the use of electricity for lighting has improved the gas business, as it has caused the people to demand more light.

The Promenade at Blackpool is to be lighted by electricity on Saturday, Sunday and Monday evenings during the winter months.

It is proposed to illuminate the Chicago Driving Park with 330 electric lights, hung over the track at intervals of only 20 feet.

Probably the largest installation of electric lighting on board ships has just been completed on the ss. *Umbria* by Messrs. J. D. F. Andrews & Co., of Glasgow. Mr. Andrews carefully studied every detail of the arrangement, and has supplied all the latest improvements of his various patented appurtenances and specially designed fittings. A very large space has been allotted for the electric machinery measuring 32 feet by 14 feet; this is situated on the lower deck midships, forward of the engine room. Here are placed four Brotherhood engines, two abreast, back to back, three of which have cylinders of 8 inches in diameter with 6 inch stroke, and one 6 inches in diameter by 4½ inch stroke. The small engine drives a Siemens 200 light dynamo, and the other three a 350 light dynamo each. There are 90 lights distributed in the engine room, stoke-holes, &c., the wires, conveying the current to these lamps being covered with India-rubber and a

special composition for resisting sea water, and over all they are sheathed with iron wire. The joints between the branch and main wires are protected with a small "T" shaped joint box of cast-iron. Each lamp in the engine room is also fitted with a switch and fusible connection the same as in every other part of the ship. The engine room lights are divided into two circuits, each with a separate switch, and each stoke hole is also on a separate circuit. The dynamos are connected to the main switch board on the bulk head close to the engines. To this switch board also are brought the six main circuits which supply the ship. No. 1 circuit supplies the night system in which there are about 200 lights including those in the engine room and stoke holes. No. 2 circuit lights the aft portion of the ship. No. 3 lights midships. Nos. 4 and 5 supply the saloon, ladies' saloon, music room, &c., and No. 6 supplies all lights forward of the saloon. Each of the main leads is carried to a group of switches at the junction of the main and branch leads, where there is also a fusible connection. Each of these switches controls a group of about 30 lights and they are placed in boxes recessed in any convenient place, in passages generally at the foot of stairs. The main branch fusible connection which protects the wires is a small circular block of wood with a groove across it in which is laid a piece of lead wire, No. 16 B.W.G., connected at each end to a screw that projects diametrically opposite sides of the block. The small branch wires lead to the lamps direct without the intervention of other fusible connections, but in the back block of the lamps there is a piece of No. 20 lead wire which protects the lamps and also shows in the event of a defect which lamp it is. An extremely simple switch is attached to each lamp. It consists simply of a screw severing connection to the lamp from the ship which is used as a return. In addition to the switch inside the room or in the lamp, there is also a switch of the same kind placed in the return wire in the passage, one for each state room. These switches are under the control of the steward. The holder is also of new design, although the same as those used by this company in their installation of the *Ems*, and it consists of four spring prongs formed from a brass tube, two of these grip the neck of the lamp which is made knob shaped to suit them, the other two have saucer shaped ends and press on to the small platinum eyes, brought out at the side of the neck or knob. As will be understood, one of these prongs is insulated from the rest by a small piece of wood forming the body of the holder, the insulated prong being attached to a pin passing through the centre of the wood. The holder is screwed on to the nozzle or nipple of the electric bracket, and in doing so the pin holding the insulated spring meets with the wire projected from the end of the nipple, thus making contact with the central wire fitting. 103 lights altogether are used in the lighting of the main dining saloon, 84 of which are suspended over the tables in very substantial and handsome 3-light electroliers or pendants hanging about two feet six inches from the ceiling. The remainder of the lamps are in small brackets and pendants to give light over the side seats. The lighting of the saloon is strikingly effective. Above the saloon is the music room, having 17 lights round the walls and over the piano and organ. The smoking room has also 17 lamps. The remainder of the lamps are distributed throughout the ship, 172 being in the state rooms. All the fittings are silver plated with the exception of those in the galleys, seamen's quarters, and engine room. On the upper deck just outside the engine room is a cast-iron box containing two switches and connecting terminals for the arc lamps. These lamps are of the same design and construction as those mentioned in our issue of May 16th, adapted to a mast head light on board ss. *Ems*. The lamp is of great simplicity, and is very suitable for the use of those not well conversant with electrical matters. In this case the lamp is arranged with double carbons. Everything in connection with the installation, including the silver plating, has been manufactured by the firm at Woodside Electric Works,

except the dynamo machines, engines, and Swan lamps. The time occupied over the installation has been a little over two months.

In referring to the above-mentioned firm we may mention that it has recently combined with its previous business that of telegraph engineers, and has secured the services of Mr. Alfred Slatter, formerly with Messrs. Clark, Muirhead & Co., as manager.

During the coming exhibition at the Alexandria Palace, we are told, the building and grounds will be brilliantly illuminated with the electric light.

Alleged Further Telephone Infringements.—Writs have been issued by the Bell Telephone Company against the Telephone Manufacturing Company, of Toronto, and the Dominion Telephone Company, for injunctions against infringement of the Bell Company's patents, by selling and using telephones similar to those patented, and for damages.

The Telephone in Spain.—The Spanish technical journals severely criticise the royal decree on the subject of the establishment of telephone systems in Spain. They prefer to see the enterprise in the hands of private companies, while the State has taken the business as a source of pecuniary profit. The price of subscription is said to be too high, and objection is made to the claim of the State to know all that is said on the subscribers' lines.

Fire Alarm Telephones in Canada.—The installation of the Fire Department telephone system at Montreal has been completed. It appears, however, that the apparatus will only be used for communications between the different stations, and will not be placed at the disposition of the public for giving alarms of fire.

Telephony in France.—Rheims is said to be the best telephonically-served town in France for its size, as it contains 210 subscribers, a proportion of .23 out of every 10,000 inhabitants. Paris, Bordeaux, and Lyons have only 14 to every 10,000.

Spanish National Submarine Telegraph Company's Cables.—The Silvertown Company informs us that it has received a telegram from Mr. Robert Kaye Gray, its engineer-in-chief, announcing the completion on Wednesday, the 5th inst., of the Las Palmas (Gran Canary), Arrecife (Lanzarote) section of the Spanish National cables. The *Silvertown* sailed from Greenhithe on Friday, the 24th ult., and arrived at Gran Canary on Monday, the 3rd inst., after having landed and buoyed the Lanzarote shore end near Arrecife, and taken the necessary soundings from thence, towards Gran Canary. Leaving again on the 4th inst. she landed the shore end near Las Palmas, and completed the cable on the following day. She then sailed from Arrecife for Santa Cruz de Tenerife, where she arrived on Sunday, the 9th inst. The s.s. *International*, after having thoroughly sounded the projected route between Tenerife and Senegal, also arrived at Santa Cruz on the 9th inst., and reports an excellent bottom for the proposed cable.

The Bennett-Mackay Cables.—An American contemporary hints that while the owners of the Bennett-Mackay cables will nominally hold the same rates as the other transatlantic cable companies, they will probably bid for patronage by offering a rebate to large customers.

Progress in Spain.—It is announced that the Bourse of Madrid will soon be connected by direct telegraph wires with the Bourses of all the other European capitals.

New Telegraph Station.—The Eastern Telegraph Company notifies the opening of a new station on the Island of Perim, at the mouth of the Red Sea. The rate to this place is the same as to Aden, viz., 3s. 9d. per word.

The Tasmanian Cable.—The Tasmanian submarine cable still lies silent at the bottom of the Straits, though Mr. Warren has been unremitting in his efforts to effect the necessary repairs; the weather has been too broken and the sea too rough to admit of the steamer continuing at work for a sufficiently long time together.

Economy in the Telegraph Department.—In order to economise space on the Post Office Telegraph "flimsies" for press messages, the latest order of 2,000,000 sheets has the heading, with the coat-of-arms, compressed into half-an-inch, instead of occupying about an inch and a half, as previously.

Telegraph Revenue.—The receipts from April 1st to November 8th, 1884, were £1,080,000; from April 1st to November 10th, 1883, £1,075,000.

Gas v. Electricity.—There have been periodically gathered together, says the *Mechanical World*, a large number of instances of damage by fire due, we are told, to the use of the electric light, and in consequence of this or because a fire *might* conceivably be caused thereby, certain rules and regulations were drawn up some time ago by the authorities for the prevention of any such incidents. After all this, it proves somewhat amusing and instructive to note that insurances upon the buildings in Antwerp for the Exhibition to be held there next year will be refused by the companies in case gas should be the chosen illuminant. So long as electrical engineers continue in the good habit of "pound wise and penny foolish," or in concrete terms use conductors amply large enough to avoid all possible overheating by excessive currents, there may correspondingly exist in the public mind a feeling of trust with regard to risk of fire from electric lighting. This point is of even more importance than the insertion of fusible lead wires; for in nine cases out of ten it is probable that the lamp is destroyed by excess of current before the fuse that is supposed to protect it. What would be thought of the fitter who carefully erects a governor on his engine but brings the steam to it from the boiler through a small iron gas pipe?

The Electric Lighting Act.—Major S. Flood-Page, Secretary of the Edison and Swan United Electric Light Company, Limited, has written to the President of the Board of Trade with reference to Provisional Orders for electric lighting granted under the above Act. He says that the time that has elapsed since the Orders held by the Swan and the Edison companies were transferred to the amalgamated company has enabled the directors exhaustively to study the question of central station lighting, as it is restricted under the Provisional Orders and the Electric Lighting Act of 1882, and they have reluctantly, but unanimously, arrived at the conclusion that they cannot establish a successful central lighting station in London under the Provisional Orders and the Electric Lighting Act. After stating that a deputation of directors would be glad to have an interview with the President of the Board of Trade on the subject, Major Flood Page criticises Clause 27 of the Act, providing that any authority may, within six months after the expiration of twenty-one years . . . require the undertakers to sell to it their undertaking upon terms of payment of the value of all land, buildings, works, materials, and plant, at fair market value, but without any addition in respect of compulsory purchase or goodwill, or of any profits which might have been made from the undertaking, as follows:—"As it would take, say, two years to erect the works, prepare the machinery, lay the leads, &c., our time is practically reduced to, say 19 years, at the end of which the undertakers are liable to be forcibly turned out. My directors feel that the financial result of such a provision renders it prohibitive. A large amount of capital must be spent on the installation of a central station, and the shareholders naturally expect to see a fair and reasonable return on their investment."

The undertakers, moreover, knowing that their time is short, practically 19 years, must set aside a large sinking fund so as to enable them to recover the capital, less the bare value of the buildings, &c., by the expiration of the 19 years. The profits, however, of this new industry must be, as in every novel enterprise, somewhat speculative and uncertain for several years, especially when the undertaking is weighed down under such restrictive conditions; it seems therefore more than doubtful whether a central station would be a financial success, and, this being so, the directors do not feel justified in expending the large amount of capital required. If any central station proved a success, the local authority would naturally buy it up at the earliest date, but, if it should prove unsuccessful, the local authority would as naturally leave it alone; if, moreover, during the next few years, by energy, fresh discoveries, improved appliances, or any other cause, the station should, after 19 years of comparative failure, be turned into a success, the local authority, and not the undertakers, would step in and reap the advantage. It is not possible to justify the application of a large amount of capital, amounting to from £50,000 to £200,000, to the establishment of a central station under such unfair and harassing conditions." With regard to Clause 18, which provides that the undertakers shall not be entitled in any way to control or interfere with the manner in which electricity supplied by them is used, he says that while it would be comparatively easy to calculate the amount of electricity which would be used to light a house, a shop, a club, or theatre, and provision could be made accordingly, it is not yet possible to estimate the amount of current that might be required in factories and workshops, when, as before long the electric current may be largely used as motive power, a compulsory supply for this purpose might necessitate laying fresh leads at a large and unremunerative expense. Referring to the Provisional Orders and the clauses providing that the undertakers shall lay down distributing mains for the purposes of general supply in every street, and part of a street specified, and maintain the same, with a penalty for default, he says:—"It is certain that in the present state of electrical knowledge and of electrical appliances, it will not pay the undertakers to provide buildings, supply plant, lay down leads, and manufacture electricity unless the current is used and paid for by the users for a certain average number of hours a day, and that therefore to compel the undertakers to go to this expense in order to supply a private house with electric light for an hour or two a day, in the lightest season of the year, is to render it certain that it will not pay."

The Patent Office.—In the House of Commons, on Monday, replying to Mr. J. Howard, Mr. Chamberlain said the Board of Trade had for some time past considered the question of enlarging the Library of the Patent Office. It had been decided to afford double the existing accommodation, and the work would be commenced as soon as the money was voted for the purpose. It was not intended to build a new patent office.

Proposed International Art Exhibition at Edinburgh.—It is contemplated, we learn, to hold an International Exhibition in Edinburgh, to include works illustrating art and industry from all quarters, during the summer of 1886.

Electricity without Motive Power.—The man Harrison, committed for obtaining money by false pretences at Manchester, by representing himself to be the inventor of a system of electricity which required no motive power, was on Tuesday, at the Manchester Assizes, found guilty, and sentenced by Mr. Justice Day to five years' penal servitude.

Railway Contracts.—Mr. H. Thorpe, of 55, Theobald's Road, has obtained the contract for the supply of a number of electrical sundries to the Great Western Railway Company for the ensuing year.

Exhibition at the Alexandria Palace in 1885.—An International Exhibition of arts, manufactures, scientific, agricultural, and industrial products, mechanical processes, and new inventions, is to be held, in 1885, under distinguished patronage, at the Alexandria Palace. The machinery section will include machinery in motion, steam-engines, agricultural implements, and all mechanical appliances and machinery used in all branches of manufacture. One-tenth of the entire receipts for admission are to be set apart for charitable purposes, under the control and management of a committee, of which Col. Sir Herbert Sandford has been appointed chairman.

The British Association.—The general committee of the British Association for the Advancement of Science met at the Royal Institute on Wednesday afternoon, when Sir Lyon Playfair was appointed president elect for the next meeting, which will be held at Aberdeen, commencing on Wednesday, September 9th, 1885. Invitations for 1886 were presented from Birmingham, Bournemouth, and Manchester, and after hearing the representatives of the different places, it was unanimously resolved to hold the 1886 meeting in Birmingham.

Telegraphy in Western Australia.—Amongst the items of expenditure for the new loan to the Western Australian Legislature are new post and telegraph offices at Perth, and a telegraph from Roeburne to Derby.

Another Gas Explosion.—Last Saturday, at a large warehouse in Great Winchester Street, a violent gas explosion took place, completely wrecking the counting house where it occurred. A man was severely burnt and shaken, and was taken to St. Barthomew's Hospital in a dangerous condition.

Royal Meteorological Society.—At the meeting of this society, to be held at 25, Great George Street, Westminster, on Wednesday, the 19th instant, the following papers will be read:—"On the injury by lightning (April 28th, 1884) to the monument to the first Duke of Sutherland at Lillieshall, Shropshire," by C. C. Walker; and "On the mechanical characteristics of lightning strokes," by Col. the Hon. Arthur Parnell.

New Partnership.—Mr. Alfred Thompson announces that he has taken Mr. Robert Ord Ritchie (late manager of Messrs. Woodhouse & Rawson's Installation Department) into partnership in his electrical and general engineering business, which will hereafter be carried on at 14 and 15, St. Swithin's Lane, under the style or firm of "Thompson & Ritchie."

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lancashire and Cheshire Telephonic Exchange Company, Limited.—The annual return of this company, made up to the 11th of August, was filed on the 6th inst. The nominal capital is £300,000 in £1 shares, of which 296,161 have been taken up and are fully paid. As compared with the previous return, the paid-up capital shows an increase of £84. Registered office: 38, Faulkner Street, Manchester.

Pall Mall Electric Association, Limited.—The annual return of this company, made up to the 6th inst., was filed on the 7th inst. The nominal capital is £15,000 in £5 shares. 400 shares have been fully paid and 2,600 (vendors' shares) are considered as fully paid. During the year a call of £2 10s. has been made upon 400 shares. Registered office: 21, Holborn Viaduct.

Iron Primary Battery Company, Limited.—This company has entered into an agreement, dated 8th ult. and filed on the 4th inst., for taking over the interests

of Messrs. Rowland Matthews and James Noad, in the letters patent dated 14th November, 1883, No. 5371, for improvements in primary and secondary batteries for electric lighting and other purposes.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph-Engineers and Electricians.

At an ordinary general meeting of this society, held on Thursday, 13th inst., a paper "On the Theory of Alternating Currents, particularly in reference to two Alternate-Current Machines connected to the same Circuit," by J. HOPKINSON, F.R.S. (of which the following is an abstract), was read:—

"In my lecture on Electric Lighting, delivered before the Institution of Civil Engineers last year, I considered the question of two alternate-current dynamo machines connected with the same circuit, but having no rigid mechanical connection between them, and I showed that, if two such machines be coupled in series, they will tend to nullify each other's effect; if parallel, to add their effects.

"Consider two machines independently driven, so as to have approximately the same periodic time and the same electromotive force. If these two machines are to be worked together, they may be connected in one of two ways: they may be in parallel circuit with regard to the external conductor, that is, their currents may be added algebraically and sent to the external circuit; or they may be coupled in series, that is, the whole current may pass successively through the two machines, and the electromotive force of the two machines may be added, instead of their currents. The latter case is simpler. Let us consider it first. I am going to show that if you couple two such alternate current machines in series, they will so control each other's phase as to nullify each other, and that you will get no effect from them; and, as a corollary from that, I am going to show that if you couple them in parallel circuit, they will work perfectly well together, and the currents they produce will be added; in fact, that you cannot drive alternate-current machines tandem, but that you may drive them as a pair, or, indeed, any number abreast. Now, if the machines are coupled in series, the resultant electromotive force on the circuit will be the sum of the electromotive forces of the two machines. The work done in any machine is represented by the sum of the products of the currents and of the electromotive forces, and it is clear that as the phase of the current is more near to the phase of the lagging machine than to that of the leading machine, the lagging machine must do more work in producing electricity than the leading machine; consequently its velocity will be retarded, and its retardation will go on until the two machines settle down into exactly opposite phases, when no current will pass. The moral, therefore, is, do not attempt to couple two independently driven alternate-current machines in series. Let A represent the two terminals of an alternate-current machine; a and b the two terminals of another machine independently driven. Let A and a be connected together, and B and b . So regarded, the two machines are in series, and we have just proved that they will exactly oppose each other's effects—that is, when A is positive, a will be positive also; when A is negative, a is also negative. Now, connecting A and a through the comparatively high resistance of the external circuit with B and b , the current passing through that circuit will not much disturb, if at all, the relations of the two machines. Hence, when A is positive, a will be positive, and when A is negative, a will be negative also; precisely the condition required that the two machines may work together to send a current into the external circuit. You may therefore, with confidence, attempt to run alternate-current machines in parallel circuit for the purpose of producing any external effect. I might easily show that the same applies to a larger number: hence, there is no more difficulty in feeding a system of conductors from a number of alternate-current machines than there is in feeding it from a number of continuous-current machines. A little care only is required that the machine shall be thrown in when it has attained something like its proper velocity. A further corollary is that alternate currents with alternate-current machines as motors may be theoretically be used for the transmission of power."*

Dr. Hopkinson then proved mathematically that—

"I. If two alternate-current machines, equal in all respects, are connected in series and independently driven at the same speed, then the leading machine may actually become a motor and do mechanical work, although its electromotive force is precisely equal to that of the following machine.

"II. If two machines are coupled parallel and connected to an external circuit resistance, then the leading machine does most work in all cases.

"III. If we suppose the terminals of an alternate-current machine to be connected to a pair of conductors, the difference of potential between which is completely controlled by connection with other alternate-current machines, then the machine may act as a motor even though its electromotive force be greater than that of the system.

* "Of course, in applying these conclusions, it is necessary to remember that the machines only tend to control each other, and that the control of the motive power may be predominant, and compel the two or more machines to run at different speeds."

"IV. In the case of an alternate current through an electric arc, if we assume that there is in the arc a constant electromotive force, E , always opposed to the current, except when the current ceases, and that then its value is zero, and that π is the electromotive force of the machine, then

$$A = E \times 0.538;$$

or, roughly, we may say that, in order that the current may not cease for a finite time, π must be at least double of A ; A will of course depend upon the length of the arc.

"The work done in the arc will be proportional to the arithmetical mean value of the current taken without regard to sign. This is of course quite a different thing from the mean current as measured by an electro-dynamometer. Taking a fairly prac-

tical case, assume $A = \frac{2}{5} E$, we then find that the work done estimated by an electro-dynamometer is nearly $\frac{1}{4}$ part too much. This will suffice to show that the matter is not a mere theoretical refinement. Another erroneous method of estimating the power developed in an arc is, to replace by a resistance and adjust this resistance till the current, as measured by an electro-dynamometer, is the same as with the arc, and assume that the work done in the resistance is the same as the work done in the arc. To obtain a maximum effect from a machine, we must have $E = \pi A$. When the resistance of the circuit is taken into account, this result will be modified. It suffices to prove that it is desirable that the potential of the machine should be materially in excess of that required to maintain the arc. In all that precedes it is assumed, not only that the coefficient of self induction of each machine is constant, but that the copper conductor of the armature is the only conductor moving in the field. If there be iron cores in the armature, we shall approximate to the effect by regarding such cores as a second conducting circuit."

In considering the question of "Secondary Generators," the author stated that "When the secondary is short-circuited a lower electromotive force of the generating circuit is required than when it is on open circuit. In induction coils the electrostatic capacity of the coils themselves has important effects. An illustration of the effect of electrostatic induction is found in the old-fashioned Ruhmkorff coils. These were not wound symmetrically, but in such wise that one end of the secondary coil was on the whole towards the inside, the other towards the outside of the bobbin. In such coils a spark to earth may be obtained from the outside end, but not from the inside. The reason is that the outer convolutions have smaller electrostatic capacity than the inner ones. The terminals may be made to give equal sparks by the simple expedient of laying a piece of tinfoil around the whole coil and connecting it to earth.

"Some time ago Dr. Muirhead told me that he had observed that the effect of an alternate-current machine could be increased by connecting it to a condenser. This is not difficult to explain; it is a case of resonance analogous to those which are so familiar in the theory of sound and in many other branches of physics.

"Some attempts have been made to verify the proposition that two alternate-current machines can be advantageously connected parallel, but I believe, till recently, without success. I had no convenient opportunity for testing the point myself till last summer, when I had two machines of De Meritens, intended for the lighthouse of Tino,* in my hands. I have made no determinations of the constants of these machines, but between three and four years ago I thoroughly tested a pair of similar machines, now in use at a lighthouse in New South Wales.* Each machine has five rings of sixteen sections, and 40 permanent magnets. The resistance of the whole machine as connected for lighthouse work (a single arc) was 0.0313, its electromotive force (E) when running 830 revolutions per minute, 95 volts. It was further remarked that the loss of power was east with a maximum load, as is shown in the following table:—

Power applied as measured in belt	3.1, 4.8, 5.6, 6.5, 5.4
Electric power developed...	0.7, 3.4, 4.3, 5.7, 3.4
Mean current in amperes	7.7, 38.6, 51.7, 73.6, 151 (P)

"Last summer the two machines for Tino were driven from the same countershaft by link bands, at a speed of 850 to 900 revolutions per minute; the pulleys on the countershaft were sensibly equal in diameter, but those on the machines differed by rather more than a millimetre, one being 300, the other 299 mm. in diameter (about); thus the two machines had not when unconnected exactly the same speed. The pulleys have since been equalised. The bands were of course put on as slack as practicable, but no special appliance for adjusting the tightness of the bands was used. The experiment succeeded perfectly at the very first attempt. The two machines, being at rest, were coupled in series with a pilot incandescent lamp across the terminals; the two bands were then simultaneously thrown on; for some seconds the machines almost pulled up the engine. As the speed began to increase, the lamp lit up intermittently but in a few seconds more the machines dropped into step together, and the pilot lamp lit up to full brightness and became perfectly steady and remained so. An arc lamp was then introduced, and a perfectly steady current of over 200 amperes drawn off without disturbing the harmony. The arc lamp being removed, a Siemens electro-dynamometer was introduced between the machines, and it was found that the current passing was only 18 amperes, whereas, if

* The engines, dynamos, lamps, optical apparatus, and lanterns of both these lighthouses have been supplied by Messrs. Chance Bros. & Co.

the machines had been in phase to send the current in the same direction, it would have been more than ten times as great. On throwing off the two bands simultaneously, the machines continued to run by their own momentum, with retarded velocity. It was observed that the current, instead of diminishing from diminished electromotive force, steadily increased to about 50 amperes, owing to the diminished electrical control between the machines, and then dropped off to zero as the machines stopped. With De Meritens' machines, I regard coupling two or more machines parallel as practically the best way of obtaining exceptionally great currents when required in a lighthouse for penetrating a thick atmosphere."

CITY NOTES, REPORTS, MEETINGS, &c.

Edison and Swan United Electric Light Company, Limited.

A MEETING of the shareholders of the Swan and of the Edison Electric Light Companies was held at the Cannon Street Hotel on Tuesday. The meeting was convened by the directors of the Swan and Edison United Company for the purpose of explaining the present position of affairs. Mr. J. Staat Forbes presided.

The Chairman said he would relieve the secretary of the ordinary duty of reading the notice calling the meeting, as it was very necessary they should know precisely what this meeting was. It was not in any sense a legal meeting; it was more in the nature of an invitation on the part of the directors of the new company to the separate members of the old companies, in order that they might learn the position of the United Company on the first annual occasion that it was possible to place it before them. The legal meeting of the United Company had already been held, the accounts had been audited and submitted, and a report had been drawn; but the liability of the concern, so to speak, being vested for the time being in the hands of the directors, they thought it would be highly improper to take any decisions upon either the report or the accounts; and they therefore determined that a copy should be sent to the respective shareholders of the separate companies, and that they should be invited to come there in order to go through substantially a meeting of the United Company, with the slight drawback that any decision they might come to would not be legally binding.

A Voice: We are like ciphers, then, Mr. Chairman!

The Chairman: Oh, no.

Are we to pass the accounts, or have they been passed?

The Chairman: You will hear, in the course of the proceedings.

The legal meeting has been adjourned pending this meeting.

Another Voice: Shall we have power to be present at that meeting? Shall we have any power or control over our own business?

The Chairman: I suppose in the sense that the directors are acting for you as mere trustees.

Is that all?

The Chairman: I think that is a good deal.

Then we have no voice in the matter!

The Chairman: I cannot imagine any greater guarantee of power than that the directors have invited you here to-day to express your views. The very object of this meeting is to know what the majority of the proprietors wish to have done; and if that is something which the constitution of the company enables the directors to do, I suppose they will do it. (Applause.) That being so, I shall proceed with this meeting exactly as if it were an ordinary meeting of the proprietors duly convened. Continuing, the Chairman said he had better point out the difficulties they had had, and the reason why they were not called together as shareholders in the Edison and Swan Company. It had been impossible hitherto on the part of either of the companies to distribute to individual proprietors the shares in the new company, the shares taken over *en bloc* from the two companies. The reason the Edison Company had been able to distribute its shares was, that it was necessary first that the company should be liquidated. The reason why the Swan Company was not able to distribute was that it only parted with a portion of its property; its share in the United Company represented its English patents, its foreign patents being reserved, and what it would have to do at a later period would be to see what machinery it would be necessary to cut to be its present share, so that one portion of it might represent the holding in the United Company, and the other the separate holding in the foreign patents. There were thus these difficulties in the way of distributing the shares, and the directors had to stand in the position of trustees, and until they could by proper and legal process distribute those shares to the individual shareholders in each company entitled to them they must bear that responsibility. Of course as soon as that could be done it would be; but practically they (the shareholders) were there that day with as much force as if they were there with legal power to vote, for their opinions would guide the decisions and acts of the trustees. He would therefore submit to them the first annual report of the United Company. Everybody of course was familiar with the reason why they were there, and why they were a united company. He believed both companies had had the story told them; the Swan Company certainly had, very fully, and he believed the Edison Company introduced the same sort of argument.

The two companies were started one independent of the other, with two great names. Mr. Edison, with a good trade mark, so to speak, and very valuable patents, and Mr. Swan with a good trade mark, and separate and distinct patents, forming a separate and distinct company; and a good business was carried on, the companies each puffing its own business and proclaiming that the patents of the other were infringements. Litigation was threatened; but fortunately some who were connected with these companies had gone through similar experiences in other cases, and wisely counselled, instead of quarrelling or division, a fusion of interests. It was quite manifest that it was much better that two such companies as the Edison and the Swan should be combined as one property than that the funds of both should be used in litigation, and that each should be pitting itself against the other upon terms that would bring down to zero the value of the article they had to sell. This principle having been admitted, there came a great practical difficulty, increased by the fact that the business was purely speculative. The Swan Company had paid large sums for its patents, which were supposed to be invulnerable, and supposed to lead to business which by-and-bye would be of enormous value; that was the Swan theory: the Edison theory was precisely the same. After a great many suggestions, and after occupying the brains of certainly not the least able or experienced men in the City of London for some time, what was done was this: each company was presumed to have acted *bona-fide*, to have purchased its patents at some rational value, and to have carried on its business in a rational manner with the view of establishing that value. Having settled that principle they determined to act upon it, taking reasonable pains to see what moneys had been spent. The directors, wisely, he thought, put the matter in the hands of Mr. Wilson, of the firm of Quilter, Ball & Co., and Mr. Price, of Price, Waterhouse & Co.; each of these gentlemen set to work, and it was upon their report, after proper and full enquiry, that in the fusion of the companies the respective proportions of shares were allotted for distribution. An agreement was entered into, carrying out all the details of the fusion, determining in the most express language possible the conditions, monetary and otherwise, under which the thing was to be united, and that agreement was submitted, as it was legally bound to be, to separate meetings of both companies. The Swan Company took a larger proportion of the shares than the Edison, because, wisely or unwisely, it had spent more money. There were various considerations to be entered into, the internal life of each company, the contracts each had undertaken, &c.; and so the administration by the articles was submitted to a delegation of four directors from each company, and that board had done a great deal of useful work since. Having explained how Sir John Lubbock, who was chairman of the Edison Company, and who was to have been the chairman of the United Company, was obliged to retire from that position for private reasons, Mr. Forbes said he was generous or weak enough to take upon his shoulders the burden of the concern for a year. The other directors were Lord Anson, Mr. Leyland, Mr. Arnold White, and Mr. Bidwell of the Edison Company; and General Trevor, Mr. Villiers and Mr. Batt of the Swan. What they had now to do was to turn the whole of the business inside out to find what there was in it, eliminate the bad, keep the good, fuse the establishments and bring down the accounts into something like tangible and reliable figures; and having done that, within the prescribed legal time, to hold the first ordinary general meeting, which they had done, but at which they had deferred taking resolutions until they had had an opportunity of submitting the position to the shareholders. Now they had before them the out-crop of all their efforts and had for the first time a balance sheet and statement of accounts of the United Company, which, whatever its other qualities, he could submit to them as being reliable and verified figures, and accurately describing the position in which the company now stood. The directors report, which was then reviewed by the chairman, was as follows:

"The directors beg to report to the shareholders the position of the amalgamated company.

"The shareholders of the Edison Company, and the shareholders of the Swan Company respectively held special meetings on 2nd October, 1883, and unanimously resolved that the Edison and the Swan Companies should be amalgamated. In accordance with these resolutions, this company was registered on 26th October, 1883—just a twelvemonth ago. The statutory meeting was held on 29th January, 1884.

"It was provided in the agreement which formed the basis of the amalgamation, and which was approved by the shareholders at the special meetings above referred to, that the financial amalgamation should date from 1st July, 1883.

"The accounts herewith presented to the shareholders include the whole capital payments, as well as the working expenses incident to the obligations and contracts involved in the amalgamation up to the 30th June, 1884. They almost entirely consist of the accounts connected with the engagements entered into by the Edison Company, the Newcastle Swan Company, and the Swan United Company, before the amalgamation, and over which the directors of this company have had no control, as they were legally binding on the company.

"The board of the new company met for the first time at the end of October, 1883, but it was not until the early part of 1884 that it became possible to reorganise and unite the staff and offices of the two companies.

"The attention of the directors has been unremittingly given to the engagements which existed when they took over the business. Many of these were undertaken in the earliest days of electric lighting, when the rivalry between the Edison and the

Swan Companies was very keen, and in some instances the work appears to have been undertaken more with a view to advertising the business than to direct profit. The board have been occupied for months in sifting these obligations. They did not renew the contracts for lighting the Mansion House; Norwich; King's Cross, and Bricklayers' Arms Stations; and the only large buildings they are now under contract to light, on the basis of a fixed annual rental, are the Glasgow Post Office, Gatti's Restaurant, the Holborn Restaurant, Messrs. Gartside's Works, and the Victoria Station. Wherever possible they have put an end to unprofitable contracts at the earliest moment they had power to do so, and have not undertaken a single new installation based upon annual rental.

"The contract for lighting Glasgow Post Office will terminate in February next, and Messrs. Gartside's in March. The rent of Messrs. Gatti's and the Holborn Restaurant may be expected to cover the expense of maintenance, so that no further loss is to be anticipated in working these contracts. The capital outlay on these works has not quite been closed.

"The central station at Holborn Viaduct, which was taken over from Mr. Edison's representatives by the Edison Company on its formation, has been a costly affair, and has caused the directors a great deal of anxiety. It was being worked at a serious annual loss, but the arrangements which existed, and the inconvenience which would have ensued to the users of the light, prevented the directors from stopping the central station immediately. They, however, closed it during the summer months, and opened it again on 1st October, on a basis which, while involving little risk to the company, will be remunerative if the whole of the power can be utilized. The customers were so satisfied with the incandescent light, that they have nearly all arranged to use the light at a fair charge, and several have increased the number of lamps.

"The works at the Victoria Station are almost complete; they have cost up to date, £17,000, and the station itself is now about being lighted.

"When the Swan United Company was formed, and agreed to purchase the Swan patents and the goodwill and business of the Newcastle Swan Company, together with the installations made by Mr. Crompton, it was believed that Mr. Swan's patents would hold good against all other patents. In the same manner the Edison Company supposed that Mr. Edison's patents gave them the virtual monopoly of electric incandescent lighting. Legal proceedings between the companies had commenced, when with the view of uniting the ownership of both patents and strengthening the company against all outsiders, and of saving the great expense of this litigation, the amalgamation was resolved upon with the unanimous approval of the shareholders of the two companies. Nothing has occurred since the amalgamation to throw doubt upon the validity of the patents of the company. An action has been commenced against Messrs. Woodhouse and Rawson which will be pressed on vigorously, and the firm has given an undertaking to the Court of Chancery to keep an account of the lamps manufactured and sold by them.

"The financial result of the position which the new company has inherited, is fully shown on the accompanying balance sheet. This shows that the capital account of the company stands at £353,478 which includes £85,695 issued in fully paid up shares, and that the assets of the company consist of about £75,000 representing stock, buildings, cash, book debts, installations, &c., a considerable amount of plant; an excellent lamp manufactory and business, which was established by the Swan Company; together with the Edison and the Swan patents.

"The working expenses of the company's business have been unduly large owing to the necessity of continuing for a time the cost of three sets of offices in London, the salaries of those employed in both companies, some of whom were under engagements, and by other causes inseparable from the state of things existing before the amalgamation of the two companies.

"The shareholders will be naturally anxious to know the opinion of the board as to the hope of a profitable business in the future. On this important question the directors do not wish to excite hopes that may not be realized. So long as unremunerative contracts exist, and expenses which they cannot control have to be provided for, there must be a certain amount of doubt. Yet they feel satisfied that there is reasonable ground for expecting that a profitable business may be established.

"The lamp factory at Newcastle is in good working condition, and orders for lamps have largely increased, and are increasing beyond all expectations. Experiments are being made with the Edison-Hopkinson dynamo which lead to the belief that it will prove the most efficient and cheapest first-class dynamo in the market, while Mr. Edison has made such improvement in his dynamos as have increased their efficiency, and the price has been greatly reduced.

"One of the most difficult questions which have engaged the attention of the directors has been that of the provisional orders, and, as every shareholder is interested in this matter, they think the best course is to send with this report a copy of a letter which they addressed in the current month to the president of the Board of Trade.

"The scientific world thought, in 1878, that the subdivision of electric light for domestic purposes was impossible. But the great discoveries of Mr. Edison in the United States, and Mr. Swan in England, led to the conclusion that the commercial as well as the scientific problem of public electric lighting from a central station had been solved. We now know, however, that it is impossible to make a central station in London pay, unless the company is relieved from the vexatious restrictions of the Electric

Lighting Act, under the provisions of which central stations can alone be legally established. As not a single London Provisional Order is being carried out, it seems reasonable to suppose that Parliament may relax its prohibitive restrictions; in which case, the directors would avail themselves of any opportunity that might offer for the establishment of a central station on a remunerative basis; they do not regard central station lighting as abandoned, but they look upon the Electric Lighting Act of 1882 as unworkable, and they await a fair and just measure which will enable them to establish central station lighting, for the benefit alike of the shareholders and the public.

"The books have been balanced to the 30th September, as may be seen by the accounts which accompany this report, and the serious loss attending past work has disappeared.

"In conclusion, the directors assure the shareholders that no effort has been spared on their part to place the company on a sound commercial basis. Much of the time of the staff is taken up by the preparation of estimates and tenders for lighting. There are companies and firms who tender at prices which cannot be remunerative if the work is properly carried out, but this company has never sent in any estimate, whether for land or shipping installations, in which provision has not been made for the work to be performed thoroughly well, and yet leave a fair profit to the company. Their tenders are frequently passed over because others are lower, but there can be no more suicidal policy than to offer to carry out electric installations at a price which cannot possibly pay, if the work is well done. As a matter of fact, every contract or installation which has been tendered for and carried out by the Edison and Swan Company, has resulted in a trading profit to the company."

A balance sheet and profit and loss account for the year to June 30th accompanied the report, and there was also issued a profit and loss account for the three months ending September 30th, which follows:—

Dr.	£	s.	d.
To stock on 1st July, 1884	13,943	4	8
" wages purchases and manufacturing charges	4,918	0	9
" cost of installations, maintenance, wages, and materials	8,536	15	9
" salaries, rent, office expenses, &c.	3,384	11	8
" depreciation on plant, &c.	409	5	10
" balance—being profit for the three months	752	11	7
	£31,944	10	3
Cr.	£	s.	d.
By sales of lamps, fittings, &c.	10,868	13	7
" sales of installations, lighting, rents, &c.	9,046	10	11
" interest and discount	75	17	7
" stock on 30th September, 1884	11,953	8	2
	£31,944	10	3

In explaining the balance sheet, the Chairman alluded to the expense and the difficulties they had had to meet in educating the public to the use of the electric light. Including the item of depreciation, £2,130, the loss on the year's working had been £28,214. They had had, roughly, £300,000 locked up, to represent which they had their patents, a first-rate manufactory, and a trained establishment. He was not particularly anxious to devote his time and money to developing a thing which he believed to be bad. He might tell them that they had reasonable ground for believing that some of the largest proprietors, notwithstanding the outcrop so far, did not take a desponding view of the position. In fact they had turned the corner, as they would see by the profit and loss account for the quarter passed. They had paid the enormous sum of £300,000 in the acquisition and manifestation of the electric patents which they possessed, and now, of course, those patents were being infringed; that was a natural consequence. They had of course resorted to legal proceedings and in these they were much strengthened by the fusion of the companies. The position was very much that which the telephone had occupied, and the results of the amalgamation of interests in that instance were well known to them. The most active infringers of the Swan and Edison patents were Messrs. Woodhouse and Rawson, two young men, and possessing all the enthusiasm of youth; he did not know whether they were using their own money or other peoples', but at any rate they were enthusiastic. The Court of Chancery had made them give an undertaking to keep an account of the lamps they sold, and if this company succeeded in establishing its case, Messrs. Woodhouse and Rawson would have to cash up. As to the sort of business the company was going to do, as far as the directors were concerned, it would not go into any more speculative business; they meant to put the risk on the shoulders of the customers, and not carry on any installations on the rental principle. This brought him to the public installations and the Provisional Orders. The Board of Trade engaged itself with an elaborate system to utilise the electric light in the interests of the public; it was likely to become such a tremendous monopoly, and people who put their money in it were likely to receive such enormous emoluments that it was to be tied up, and the public, unable to take care of itself, was nursed and pampered in every way by the Electric Lighting Act. They had a great many misgivings of being able to work under this Act, but it would not do to be left out in the cold, so they obtained a Provisional Order, and having got it they knew now exactly what it was worth—nothing. The provisions of the

Electric Lighting Act had made public lighting impossible, and they were not going to enter upon any business of this kind. They were not going to buy any more inventions, nor run the kind of risk involved in street lighting or house-to-house lighting, or anything but that which would pay. With this general principle before them, the conviction of the directors was that, notwithstanding that their shares had no value and the difficulties that faced them, there was reasonable ground for believing that, prudently managed, the company might retrieve itself and present a very good future. A good deal would turn on the establishment of the patents, but even setting them aside, with the names of Edison and Swan behind them they ought to do better than any competitor. According to the articles of association, the directors retired *en bloc*. He dared say they were all willing to retire if that were the pleasure of the proprietors, but as honourable men, having assumed the responsibility of conducting the company so far, they had enough self-respect to be quite willing—some of them at great personal sacrifice of time and labour—to go on and see if it be not possible to put the business on a sound basis. He had no resolution to move, but he should like to put it before them that the report and accounts be received. The moral effect of this would be exactly the same as the legal effect. (Applause.)

Lord Anson said, after the elaborate statement made by Mr. Forbes, it was unnecessary for him to make many remarks. He thoroughly agreed with all the chairman had said as to the causes of the great loss shown on last year's trading, and also as to the possibility, and even probability, of this concern being turned into a more profitable one. It would be a great mistake if they now made up their minds to stop the company altogether. If they could only hold their own for a very short time there was a prospect of their doing very well. He believed all the Edison shareholders were aware that that company was in liquidation. They had done their very best to bring that result about. And he should like also to say how thoroughly the Edison directors appreciated the friendly way in which they had been met by the chairman and his Swan colleagues. It might have been supposed that, with the conflicting interests, there would have been some degree of friction between the representatives of the two companies; but he was happy to say that they all had but one idea, and that was to make the United Company a success.

Mr. Kempster rose to move the following resolution:—"That in the opinion of this meeting it is desirable that a committee of, say, seven shareholders, with power to add to their number, should be elected, who shall fully inform themselves as to the past working of each of the two companies prior to their amalgamation, the present position of the 'United' Company, and its prospects of successful working; also that such committee should confer with the directors, and, if deemed necessary, report to the shareholders, as to any steps considered by them advisable for placing the company upon a sound commercial basis." That resolution, he said, he moved in no unfriendly spirit to the board, but he submitted with great respect that the present position of the company was such that the shareholders had a right to obtain independent information; the only way of obtaining such information being by means of a committee appointed from their own body. He was there as a small shareholder representing other shareholders who held a large number of shares. It was quite certain that the relations between the board and the shareholders were considerably stained, and he thought there was something like a link needed, which he believed the committee would supply, to restore that confidence which it was desirable should exist between shareholders and directors, and give some new hope as to the future working of the company. It would not do for things to go on as they had been, and as they were going on now. What was more unsatisfactory than the position of that meeting? They met informally after three years, during which time they had not had a single meeting at which they had had any power whatever, and now they were told, courteously and considerately, it was true, that they could do nothing which would have any legal effect. He submitted that the shares might have been so distributed as to have given them the power to which they were entitled. They had had a long and able speech from the chairman, but there was not a particle of real information in it; nothing more than was practically common knowledge beforehand. They had had no practical details of the working of the one company or of the other, or of the amalgamated company. They wanted to know something more as to the results of their contracts; what was done with the money subscribed in the Swan Company; and many other things, which at a general meeting it was impossible to elicit, but which a committee could competently deal with. There was yet no register of the shareholders of the amalgamated company, although the company itself had been registered. He did not know, too, whether the shareholders were aware that the amalgamated company were bound to pay the costs of the liquidation of the two old companies.

The Chairman: What you are stating is not correct. So long as you confine yourself to argument we will listen, but when you give mistaken statements of fact it is necessary to prevent the shareholders being misled.

Mr. Kempster said he had read the documents a few days before, and he was under the impression that such was the case.

The Solicitor stated that the 11th clause of the agreement stipulated that the amalgamated company would only pay the costs of the liquidation of the Swan Company in the event of that company being wound up within six months, and that date had now expired.

Mr. Kempster apologised for the error into which he had fallen,

but remarked that they, at any rate, had the costs of the liquidation of the Edison Company, and as shareholders in the Swan Company they still had the burden of that, so that it amounted to very nearly the same thing. There were other questions, as to the disappearance from their service of gentlemen who had received very large sums of money and who they had expected would give them valuable assistance. There were questions as to Mr. Swan's standing in the company, and as to Mr. Crompton's leaving them, and also as to whether it was not possible now to cut down the working expenses to a great extent, and to find out the value there was in the concern, and whether they could not work only the profitable part of the business so as not to incur a loss.

Mr. Sudworth seconded the resolution.

Mr. J. H. Greenhill said that from what had been said it seemed the company depended altogether upon one thing, the establishment of its patents. It was all very well to take a favourable view of the result; but suppose an unfavourable verdict were given? They would then, practically, have paid a large amount of money for nothing. He would advise them to meet the thing boldly, and simply say the money was lost. But it would be a great mistake to wind up the company, for he believed that, with due economy in the working expenses, a profitable trade could be carried on, even if they did lose the money paid for the patents, in manufacturing and selling lamps; but let the company keep to what it could legitimately perform—the manufacture of the best possible lamps at the lowest possible price. He hoped that if the result of the actions pending should be in their favour it would not cause them to raise the price of the lamps to the public.

Mr. Tipping protested against the adoption of that miserable and fussy expedient—a committee of shareholders. If they wished to put a company which was a little "touchy" on its last legs, the appointment of a committee would do it. He had had some experience of committees, and opposed the resolution most strongly.

Another shareholder entirely agreed with what was said by the speaker, and warned the shareholders against adopting a suicidal policy by entrusting their property to a committee who could not possibly know the business so well as the directors.

Sir John Lubbock said he thought the absence of any check upon the action of the directors was rather imaginary than real, for knowing the gentlemen on the board as he did, he was quite sure the wishes of the shareholders would be observed. He hoped they would hesitate before agreeing to the appointment of a committee. He did not take by any means so hopeless a view of this concern as some apparently did. They had no doubt paid largely for the patents, but at the same time he saw nothing to lead them to doubt that they were of considerable value; and they must remember that the company had been working hitherto without the full advantage of its patents, as these had been infringed. It was a very doubtful expedient to adopt to appoint a committee; he liked to know upon what shoulders the responsibility rested. They had a board of directors whose honesty was undoubted, and he thought the affairs of the company should be left to them and not be put into the hands of a few shareholders of whose motives they knew nothing, and who knew nothing at all of the business. A committee of gentlemen unacquainted with electrical matters would be of no use, and he asked them if it was desirable to let them have free access to the inner working of the company if they were acquainted with the technical parts of the business.

Mr. Stevenson, M.P., also deprecated strongly the proposal to appoint a committee.

Mr. Kempster said after the discussion which had taken place, he thought he should best consult the feelings of the shareholders by withdrawing his resolution, as it seemed to be the opinion that after the elaborate statement of the Chairman it would not be advantageous to appoint a committee at the present stage. He would only say that the friends who had been conferring with him would still continue to do so, probably, so that they might have some means of working together.

The Chairman expressed his pleasure that Mr. Kempster had withdrawn his resolution, as he should have felt it his duty to oppose it tooth and nail. Probably no one had had more experience of committees of shareholders than he, and of all the machines for ruining a company, he was of opinion that that was the most effective.

After a little further desultory conversation,

Sir John Lubbock moved a vote of thanks to the Chairman, which was unanimously carried, whereupon the meeting terminated.

Edison's Indian and Colonial Electric Company, Limited.—A petition is pending for confirmation of a special resolution reducing the capital of the company from £250,000 to £117,500. The list of creditors is to be made out as for February 28th, 1885.

French Electrical Power Storage Company, Limited.—Mr. Arthur Cooper, of the firm of Cooper Brothers & Co., has been appointed by Vice-Chancellor Bacon official liquidator of this company.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending November 7th, were £3,034; after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

NEW PATENTS—1884.

14601. "Dynamo-electric machines for plating and depositing metals." G. F. CHUTTER. Dated November 5.
14649. "Telephonic apparatus." J. STEPHEN. Dated November 6.
14652. "Telephonic apparatus." J. STEPHEN. Dated November 6.
14655. "Simultaneous use of voltaic and induced electric currents in systems of telephonic intercommunication." F. TREMAIN, A. PIKE. Dated November 6.
14673. "Covering electrical conductors with plastic materials." G. C. TAYLOR, E. T. TRUMAN. Dated November 6.
14693. "Apparatus for automatic registration of numerals by electricity." C. FORD. Dated November 7.
14723. "Electric generators." Hon. C. A. PARSONS. Dated November 7.
14767. "Driving and steering mechanism for common road vehicles to facilitate their propulsion by means of electric accumulators, &c." H. J. HADDAN. (Communicated by D. Barnier.)
14779. "Dynamo-electric machines." W. R. LAKE. (Communicated by L. Bollmann.) Dated November 8. (Complete.)
14818. "Current reverser." H. C. HAROLD. Dated November 10.
14829. "Dynamo-electric machines." J. H. GREENHILL. Dated November 11.
14840. "Primary batteries." R. A. LEE. Dated November 11.
14846. "Insulators." L. GUTMANN. Dated November 11.
14852. "Insulator for electric purposes." L. A. GROTH. (Communicated by J. Wolf.) Dated November 11.
14865. "Applying electric alarms to the face of any clock." A. W. WILSON. Dated November 11.

ABSTRACTS

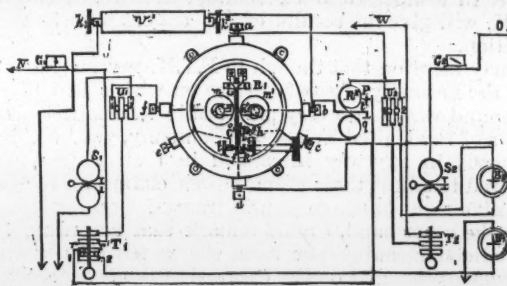
OF PUBLISHED SPECIFICATIONS, 1884.

199. "An improvement in voltaic batteries." R. APFLEGARTH. Dated January 1. 2d. Consists in a vessel of carbon of cylindrical or any other suitable shape, grooved, fluted or corrugated inside or outside, or both and intended, while holding the exciting liquid or electrolyte, to serve also as the negative electrode, the purpose of grooving, fluting, or corrugating the carbon vessel as aforesaid, being to increase the active surface thereof in a manner similar to that described in the specification of the inventor's patent for fluted, ribbed, grooved, or corrugated carbon plates bearing date the 19th day of June, 1883, and numbered 3026. Any number of these carbon vessels may be arranged inside one another with intermediate anodes or positive elements so as to form a powerful battery in a very small space.

1709. "Improvements in accumulators or secondary batteries." E. P. ALEXANDER. (Communicated from abroad by J. L. Moisy, the younger, of Paris.) Dated January 18. 6d. According to this invention the accumulator is composed of bands or strips of lead of any suitable size and thickness cut in the form of combs. These combs are doubled or folded on themselves any desired number of times, and their ends joined together so as to present the appearance of a brush of lead. Two of these brushes placed facing each other, and separated by a sheet of gutta percha, form an element of the battery. The teeth of these brushes may be inclined or cut at any angle to facilitate the escape of the gaseous bubbles as they are produced.

2078. "An improved construction and arrangement of relay apparatus for electric telegraphs." C. D. ABEL. (Communicated from abroad by J. Kölzer, of Germany.) Dated January 24. 6d. Relates to an improved construction and arrangement of electric telegraph apparatus for transmission from line current to working current, and vice versa. In order to render such a transmission possible, the polarised relay at present in use requires a different arrangement and construction from that which is employed for the simple transmission of a working current. The fig. shows this improved construction and arrangement. The armature or tongue of the polarised relay is extended and has its front end bent twice at right angles so as to form a hook, and on its extremity is a projection, *k*; this hook has for its object to limit the motion of the steel spring, *i*, and, at the same time, to conduct the electric current, arriving from *o* through *i* to *c* *c* - *w*, and to affect, together with the spring, *i*, the opening and closing of the line current, *o* - *w*. On the right hand side of the armature is a small but very elastic adjustable spring, *i*, attached to the armature by means of two screws, but insulated therefrom by a plate of insulating material, *o*. This spring when at rest lies against the projection, *k*, thus making contact. On the insulating plate, *o*, at the level of the contacts, *l*, *l*¹, is a small stud, *j*, against which the spring, *i*, is pressed, so as not to be brought with its whole surface in contact with the plate, *o*. On the relay to the right of the armature, is a small fine wire coil, *g*, connected

at one end to the spring, *i*, and at the other end to the contact screw, *h*, which is insulated from the relay, and is connected to the contact screw, *c*, also insulated from the relay. The coil, *g*, lying almost parallel with the armature of the relay, participates in the movement of the armature, without materially affecting the same. The operation of the polarised relay is sufficiently well known, and need therefore not be further described. It may, however, be stated that in regulating the same, the movable polar extensions, *n*, *n*¹, are not arranged equidistant from the central position of the polarised armature or tongue, *c*, *c*¹, the extension, *n*, which corresponds to the rest contact, *l*, being nearer the armature than the extension, *n*¹. In this case, so long as no current passes through *m*, *m*¹, the attraction of the north pole, *n*, for the south polarised armature, *c*, overbalances that of the north pole, *n*¹, and consequently *c*¹ is continually drawn towards *n*, so as to make contact at *l*; the spring, *i*, then rests upon the contact, *k*, and keeps the line circuit, *o* - *w*, closed at that point; on exciting the relay by a line current the same end is attained if the polar extensions are reversed and the battery poles are changed. The key, *r*¹, has a divided working contact plate, *r* and *r*¹, as shown. The small part to the left is connected with the contact, *p*, of the relay, *r*²; on the larger part to the right is situated the working contact, and, in addition, a battery plate, *v*. The connections of the apparatus are effected as shown in the fig. *n*¹ is a polarised relay, *r*² a Morse relay; *s*¹, *s*², are writing apparatus; *u*¹, *u*², the two commutators; *t*¹, *t*², the keys; *a*¹, *a*², the galvanoscopes; *b*¹, the battery for the working current; *b*², that for the line current; *w*¹, a large artificial resistance, which must be greater than the total resistance of the circuit, *n*; *o* - *w*, the line circuit; *n*, the working circuit. For transmitting a message from the circuit, *o* - *w*, to the working circuit, *x*, or the converse, the holes, *l*, are stoppered at *u*¹, *u*², and *t*¹. The course of the current in the line circuit from *o* to *w* is then as follows:—*o*¹, *a*², *s*², *b*², *u*², *r*², *c*, *h*, *g*, *i*, *k*, *c*¹, *c*, *a*, *u*¹ (over hole 1), *t*², *w*, &c., &c., so that the armature levers at *s*² and *r*² are attracted and lie against the rest contacts. The course of the current in the working circuit is as follows:—*n*, *a*¹, *t*¹, *u*¹ (over hole 1), *f*¹, *m*, *m*¹, *b*, *r*², through *w*¹ to *r*¹, and to earth. If now, by the depression of a key the line current is broken in the circuit, *o* - *w*, then *s*² and *r*² are out of action, the armature lever, *t*, at *r*² moves against the contact, *p*, the working current of the battery, *b*¹, is closed, and passes (the battery having one pole to earth) *b*¹, *t*¹ (hole 1, *r*), *r*² (by contact, *p*, armature lever, *t*), *n*¹ (by contact screw, *b*, wire



coils *m*¹, *m*, contact screw, *f*¹, *u*¹ (hole 1), *t*¹ (rest contact plate, body of key), *a*¹ to circuit wire, *n*, and actuates the writing apparatus at the distant station. This current must be led through the coils, *m*¹, *m*, of the relay, *r*¹, in such a direction that a south pole is produced at *n*¹, and a north pole at *n*, in order that the armature may be held by *n* so as to lie against the contact, *l*; the outgoing current will not take the direction to earth through *b* (*r*², *k*¹), because this offers too great a resistance, but will pass through the line wire, *n*, having a less resistance. If now the distant station of the line wire, *n*, sends a line current in such manner as to form at *m*¹ a north pole, and at *m* a south pole, then the residual north pole magnetism in *n*¹ will be strengthened, and the north magnetism in *n* will be neutralised, so that the attraction for *n*¹ to *c* will be the greater, and in consequence hereof, the extension of the armature, *c*¹, *c*, will be brought with the spring, *i*, against the working contact, *l*¹, thus closing the local circuit of battery, *b*² (through *l*¹, *a*, *b*², *u*², *r*², *c*, *h*, *g*, *i*), and causing the spring to be moved away from *k*, and thereby breaking the line circuit, *o* - *w*. If the current in the line wire, *n*, ceases, the armature, *c*¹, *c*, moves back again. The spring, *i*, remains so long against the contact, *l*¹, until it is reached by the projection, *k*, thereby closing the line circuit, *o* - *w*, and then moving away from *l*¹, whereby the local circuit will be opened at *l*¹, *i*. The armature lever of the relay, *r*², will remain against the rest contact, whereby the entrance of a current into line wire *n* is prevented, because the local circuit (*l*¹ - *i*) is closed before the line circuit (*o* - *w*) is broken. By this means, therefore, the difficulty is overcome which heretofore has rendered similar transmissions unsuitable for practical use. The connecting system of the circuit *n* with the circuit *o* - *w* is separated as follows:—At *t*¹ and commutator *u*² the stopper is moved from hole 1 to hole 2. The current of the line circuit, *o* - *w*, then passes through *o*, *a*², *s*², *r*², *u*² (hole 2), *t*², *w*, &c., &c. The armature lever, *t*, of the relay, *r*², moves away because there is no current in this part, and a permanent current would enter the circuit, *n*, if the stopper at *t*¹ were not moved from hole 1 to hole 2, whereby the battery is transferred from contact *r* to contact plate *r*¹. If now a station on circuit *n* calls, the relay, *r*¹, comes into action, whereby the local

current, $v^1 - i$, will be closed, the relay, x^2 , comes into action, in this case with the property as working current. The fact that stations in circuit n calls stations in circuit $o - w$ can therefore be ascertained, so as to effect the connections of the two circuits and to allow them to communicate. The circuit, n , is arranged for writing apparatus, s^1 , by the cutting out of the two relays, x^1 and x^2 . Should it appear necessary for any reason to separate circuit n from circuit $o - w$ and the connecting system, and to connect it to a separate apparatus, the stopper at the commutator, v^1 , is moved from hole 1 to hole 2. The connecting system is now cut out, and the writing apparatus, s^1 , put in circuit. The course of the current in n is now as follows:— n, g^1, t^1, v^1 (hole 2), s^1 , and to earth. The outgoing current passes, if key r^1 be depressed, through s^1, t^1 (hole 2), g^1 to n , &c., &c.; the circuit is in this case an independent one. By the above-described invention a single wire branch circuit may be established at any point of a main circuit capable of operating with the latter in the same manner as this operates in itself.

11914. "Improvements in electro-mechanical signalling apparatus and the system therefor." M. TOULMIN. Dated September 2. 6d. Relates to certain new and useful improvements in electro-mechanical railway signalling apparatus, and the system therefor, in carrying out the purpose for which it is designed, that a number of such apparatus shall be placed along a railway track, at such intervals as the natural conditions of the country through which the road passes, require,

CORRESPONDENCE.

The Telephone Patents.

I must thank F.T.H. for his long and interesting answer to my query as to transmitter diaphragms.

Though I am well aware that it is the habit of the United Telephone Company to take legal proceedings against manufacturers of telephonic apparatus, still I am not as yet acquainted with their methods of procedure in such cases, and I should, therefore, be glad if F.T.H. will give the results of his experiences in this direction.

I may mention that though to F.T.H. my suggestion as to the necessity of some surface on which to collect the sound waves in every practicable transmitter may savour of the United Telephone Company, yet I am by no means in any way interested in their defence, or prepared to admit their preposterous claims as to the exclusive right to use carbon in transmitters.

On the other hand, I must remark that according to the judicial meaning put upon the words *diaphragm* and *tympanum*, and on the expression *tympanic action*, it does not appear so very easy to make a workable instrument to clear Edison's patent as your correspondent F.T.H. seems to imagine.

Again, I fear that if he will refer to the report of "The United Telephone Co. *versus* Maclean," he will find that the great weight of evidence was on the side of the microphone working as part of a *closed* circuit, and that when a break in continuity does occur, instead of producing articulation, it destroys it.

Once more I cannot admit that a permanent magnet is "the obvious equivalent" of an electro-magnet in the main circuit or line wire, and an electro-magnet in a local circuit appears to be claimed in the patent.

I do not know, moreover, how the case may be influenced by the patents that were formerly held by the London and Globe Company, and which have now passed into the hands of the United Company.

Certainly, the claims in patent No. 676, 1883, of H. H. Eldred, appear to be for the most part either of small importance, or were repetitions of improvements advocated in the *English Mechanic* and other papers of years ago, and I cannot admit that the waterproofing of the membrane diaphragm with a coating of varnish—a claim which, by the way, is not mentioned in the provisional specification, and which cannot be considered an equivalent of a "disc of mica or brass"—is either novel or a fit subject for a patent at all. Still, I am not aware, though perhaps some correspondent will enlighten me, what other patents have passed to the United Company which may have any bearing on the present state of the case.

In conclusion, I would ask if any correspondent is

acquainted with the reason for the *three* terminals that exist in some of the "Globe" receivers, most instruments having but two. Are there two separate coils, and what are they both for?

I fear that my contributions to this correspondence are, for the most part, a mere series of queries; but I believe that the replies that are being obtained will interest others besides myself, and will clear the way for the destruction of a monopoly.

November 10th, 1884.

S.

The Electric Lighting Act.

If your correspondent, "Ohm," will apply to me I shall be happy to furnish him with the information he requires relative to the cost of a license from the Board of Trade under the Electric Lighting Act, 1882.

The house-to-house lighting at Colchester is supplied by this company under, I think, the only license at present being worked.

Geo. Offor, Manager,
THE SOUTH-EASTERN ("BRUSH") ELECTRIC
LIGHT AND POWER CO., LIMITED.

68A, Cow Cross Street.
London, Nov. 8th, 1884.

The Work that a Dynamo can Perform in terms of its Dimensions.

The following remarks are intended more as illustrative of a principle than referring to a practical law.

To fit up a dynamo installation most economically, using a dynamo of a particular type, the size of the dynamo, the resistances of the armature and field-magnet, and the velocity of revolution should be so adjusted to each other that the value of the energy realised in the exterior circuit, minus the value of the energy wasted in the dynamo and the interest upon the total cost of the installation, is a maximum.

When in a dynamo of a certain size the best value of the exterior resistance, the resistances of the armature and of the field-magnet have been found, then the proportion of these resistances to each other should be observed in other dynamos of different sizes, when producing equally efficient machines. Assuming, then, that the proportion of the resistances of the exterior circuit, the armature and the field-magnet is the same in machines of different sizes, and that the linear velocity of the armatures is constant, then the electromotive force of the different dynamos would be proportional to the length of their armature circuits, that is proportional to $\sqrt{\text{weight} \times \text{resistance}}$, so that by the aid of a constant the electromotive force of a dynamo may be expressed in terms of its weight and resistance

$$\therefore E = \sqrt{w \cdot r \cdot c}$$

where w = the weight and r the internal resistance of the dynamo, and L the exterior resistance—also, since the total work done in the circuit equals $\frac{E^2}{L + r}$, therefore the work performed by the dynamo

$$= \frac{E^2}{L + r} = w \frac{r}{L + r} c = w k$$

The electromotive force of a dynamo may therefore be defined by its weight, resistance and a constant, and its power by its weight and a constant only.

W. Moon.

CHARLES SMITH.—*Van Nostrand's Engineering Magazine* can, we think, be obtained in London of Messrs. Trübner & Co., Ludgate Hill, or of Messrs. E. & F. N. Spon & Co., Charing Cross. The *Scientific American* can be subscribed for through Messrs. Sampson, Low & Co., Fleet Street. We doubt if single copies or back numbers can be had in either case.—[EDS. ELEC. REV.]

PATERSON & COOPER, ELECTRIC LIGHT AND POWER AND TELEPHONE ENGINEERS,

ST. PAUL'S WORKS—76, LITTLE BRITAIN, LONDON, E.C., AND
EUROPEAN TELEGRAPH WORKS—POWNALL ROAD, DALSTON.

Prize Medals, International Electrical Exhibitions, Paris, 1881, London, 1882, and Calcutta, 1884.

MANUFACTURERS OF

DYNAMO MACHINES, ARC LAMPS, AND ALL ACCESSORIES FOR ELECTRIC LIGHT INSTALLATIONS.

DYNAMOS.—PATERSON & COOPER'S Phoenix Dynamos for Incandescent or Arc Lighting; Slow-speed Machines for Ship Lighting; Dynamos for Electro-Deposition of Metals.

SEARCH LIGHTS.—Submarine Arc Lamps for Salvage or Fishing.

ENGINES.—High Pressure and Condensing; Steam Boilers; Turbines, Water Wheels, Overshot Breast and Undershot; Shafting, Pulleys, Plummer Blocks, Gearing, Belting, &c.

ARC LAMPS.—Licensees and Manufacturers of the Clarke-Bowman Arc Lamp, the Pilsen Arc Lamp, the "T.F." and other lamps.

INCANDESCENCE LAMPS.—Agents for Swan, Edison, Bernstein and other incandescence lamps.

MEASURING INSTRUMENTS.—Cardew's Universal Voltmeter, Paterson's Patent Electro-magnet Am and Voltmeters, and Engine-room Ammeters; Ayrton & Perry's Am and Voltmeters, Ohmmeters, Powermeters, Tachometers, &c.

CARBONS.—"WALLACE DIAMOND" Carbons, as used at Severn and Mersey Tunnel Works, Great Western Railway Company, International Health Exhibition, &c.; HARDTMUTH'S SOFT CORE CARBONS.

FITTINGS.—Sockets, Holders, Lamp Reflectors, Brackets, Improved "R.E." and Maynard Switches; Safety Cut-outs, and all requirements for electric light installations; Cables of all descriptions.

TELEGRAPH INSTRUMENTS.—Telephones, Switchboards, Magneto Call Bells, "S.N." Instruments, Railway Signal and Speaking Instruments, Tapper Bells, &c.

EXPLODERS & TORPEDO GEAR.—Admiralty and Mackenzie Firing Keys; Fuse Exploders for Blasting.

Engineering and Electrical Work of all sorts carried out. Estimates and Specifications for Electric Lighting free of cost.

ELECTRIC LIGHT LEADS, GUTTA-PERCHA, INDIA-RUBBER COMPOUND BRAIDED COTTON, SILK-COVERED WIRES.

PHILLIPS BROS.,

ELECTRICAL WIRE MANUFACTURERS,

THE LEA TELEGRAPH WORKS, HACKNEY WICK,

LONDON,

FORMERLY OF

MACINTOSH LANE, HOMERTON.

ESTABLISHED 1870.

SPECIAL WIRES FOR DYNAMO MACHINES

SPECIAL WIRES FOR INCANDESCENT LAMPS

GERMAN SILVER WIRES FOR HIGH RESISTANCES, FLEXIBLE CORDS, TELEPHONE WIRES, &c., &c. MULTIPLE, AERIAL, AND SUBTERRANEAN CABLE WIRES TO ANY SPECIFICATION.

INDIA-RUBBER, GUTTA-PERCHA, & TELEGRAPH WORKS COMPANY, LIMITED.

Offices and Warehouses: 108 & 100, CANNON STREET, LONDON, E.C.
Works: Silvertown, Essex; Persan-Beaumont, France.

TELEGRAPH ENGINEERS AND MANUFACTURERS OF

CABLES.—Submarine, Subterranean, and Aerial.

WIRE.—India-Rubber and Gutta-Percha covered in all gauges.

INSTRUMENTS.—"Morse" Inkers, Single Needle, Wheatstone's Alphabetical, Semaphore "Block" Instruments, Bells, Resistance Coils, Sir W. Thomson's, and other Galvanometers, Condensers, Testing Instruments, &c.

BATTERIES.—SOLE MANUFACTURERS FOR GREAT BRITAIN, IRELAND, AND THE COLONIES OF THE CELEBRATED LECLANCHE BATTERY, which has received the most favourable reports from the Postal Telegraph Authorities and other eminent Telegraph Engineers, and is now in general use by the Post Office and English and Continental Railways. As a Battery for all Telegraphic purposes it is undoubtedly pre-eminent. All other kinds of Batteries also manufactured. Ebonite Cells, Carbon Plates, &c.

INSULATORS.—Ebonite, Porcelain, Brownware, &c.

MANUFACTURERS OF THE MOST IMPROVED APPARATUS FOR RAILWAY BLOCK SIGNALLING.

SEMAPHORE REPEATERS, "LIGHT" INDICATORS, AND WALKER'S "PASSENGER AND GUARD" COMMUNICATOR.

TELEGRAPH STORES AND APPARATUS OF EVERY DESCRIPTION.

TORPEDO APPARATUS.

THE INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPH WORKS COMPANY (Limited) are Patentees and Manufacturers of a Complete System of Torpedoes for Harbour and Coast Defence,

AND OF THE

SILVERTOWN PATENT FIRING BATTERY.

A Constant Battery for Mining and Blasting Purposes.

CONTRACTS ENTERED INTO for the SUPPLY, CONSTRUCTION, and MAINTENANCE of TELEGRAPH LINES.

MANUFACTURERS OF

VULCANISED INDIA RUBBER.

VALVES, SHEET, BUFFERS, SPRINGS, WASHERS, WHEEL TYRES, CORD TUBING, AND DOOR AND CARRIAGE MATS.
INDIA RUBBER AND CANVAS SUCTION AND DELIVERY HOSE.

INDIA RUBBER and CANVAS STEAM PACKING—ROUND, SQUARE, and SHEET.

INDIA RUBBER MACHINE DRIVING BANDS.

WATERPROOF GARMENTS AND FABRICS:

Coats, Capes, Leggings, Hats, Helmets, Knee Wrappers, Diving Dresses, Sheetings for Hospitals, Water and Air Proof Bags, Pillows, Cushions, Bottles, Baths, Life Belts, Gas Bags.

EBONITE.

Not affected by Vinegar or Hydrochloric or Acetic Acid.

Pumps.
Photographic Articles.

Speaking Tubes, Mouthpieces.
Battery Cells.

Sheet and Rod.
Surgical Appliances.

GUTTA-PERCHA.

Tubing, Balting, Buckets, Bases for Flax Spinning, &c.

WORKS: SILVERTOWN, ESSEX, LONDON, E.; PERSAN-BEAUMONT, FRANCE.
London Office—106, CANNON STREET, E.C.
Warehouse—100, CANNON STREET, E.C.

BRANCHES:

LIVERPOOL	...	52, Castle Street.	BELFAST	...	32, High Street.
GLASGOW	...	20, Dixon Street.	DUBLIN	...	15, St. Andrew Street.
BRADFORD, YORKSHIRE	...	55, Kirkgate.	BRISTOL	...	27, Corn Street.
SHEFFIELD	...	10, Castle Street.	NEWPORT, MON.	...	22, Dock Street.
PORTSMOUTH	...	40, High Street.	CARDIFF	...	Pierhead Chambers, Bute Dock.
NEWCASTLE-ON-TYNE	...	21, Grainger Street, West.			